# Infinite Energy

Cold Fusion and New Energy Technology

Published by Cold Fusion Technology Vol.2, No.8, 1996

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# Infinite Energy

## Cold Fusion and New Energy Technology

**Volume 2, No.8, May/June 1996**

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**Top:** Actor Keanu Reeves in *Chain Reaction*, a recent Hollywood techno-thriller that focuses on the serendipitous discovery of energy from water. Reeves as "Eddie Kasalivich" contemplates his breakthrough.

**Bottom:** Reeves escapes a titanic explosion of the fictional hydrogen energy lab.

*Photos courtesy 21st Century Fox*

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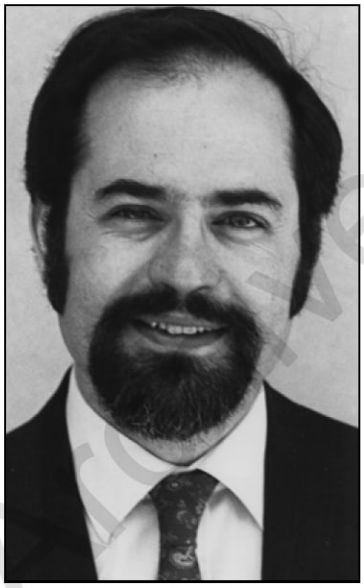
*By Eugene F. Mallove, Sc.D.*

# Stranger than Fiction



It is commonly said that fiction is often far less strange than truth. The several Hollywood movies that are now or are soon to be bringing "energy from water"—free energy— into the public arena are a case in point. *None of these movies can even come close to the basic facts of the cold fusion / new energy saga.*

We at *Infinite Energy* are acutely aware of this "stranger than fiction" aspect of our field. Of course, the opponents of scientific investigation in this area would say that this science *IS* fiction, and therefore it is very strange! These are the opinions of the *paradigm paralyzed* who "refuse to look through the telescope" to see new vistas. "I have had fifty years of experience in nuclear physics, and I know what's possible and what's impossible," said MIT Professor Hermann Feshbach to me in 1991. "I don't want to see any more cold fusion evidence; it's all junk!" he continued angrily.

Well, this "junk" is now emerging as one of the greatest revolutions in the history of science. Yet to know that this revolution is occurring, one has to be among the select group of forward-looking individuals who read this magazine and its allied publications. **Here we are, at the end of the 20th century, the age of the "information superhighway"— the video age, and the basic facts of this new energy revolution are all but invisible in mainstream media.**

What could be stranger than this?: There is an issue of paramount importance to the public: cold fusion and new energy; it is not secret; major corporations and major industrial nations are already participating in the field, Japan to the tune of $100s of millions of dollars already; it could change the way nearly every person on the planet views the future of humanity, possibly from deep pessimism to wild optimism. And yet, this idea resides in the consciousness of only a minute fraction of people today.

It is deeply ironic that the current techno-thriller movie, *Chain Reaction*, speaks clearly in its *fictional* way of mysterious energy from water that could change the world, while the media organs of the scientific establishment have written-off mountains of *factual* evidence that this energy source really *does* exist—whatever its explanation turns out to be! When they aren't simply ignoring the field, we get from *Nature* and *Science* magazines one of two types of energy-from-water stories: (A) Some "cutesy," allegedly pathetic, or crazy thing has just happened in the "cold fusion" field or (B) Hot fusion researchers are struggling valiantly to preserve or increase funding for their schemes to mimic the stars and *maybe* (hah!) give us a working thermonuclear reactor in 25 to 50 more years!

Recently, some general media stories about the well-established sonoluminescence phenomenon link it with the possibility of *hot-fusion* in water, given the well-known high-temperatures of collapsing cavitation bubbles. They never mention *cold* fusion and they certainly do not mention the work of the E-Quest Sciences corporation or HydroDynamics, Inc. —extracting energy from water via cavitation bubbles.

Are these media malicious or merely stupid? Probably a little bit of both, though likely more of the latter. Let's face it, the Big Lies about cold fusion —"it can't be reproduced," "it's pathological science," etc., etc.— were unleashed by a relatively small clique of like-minded scientific bigots and bureaucratic turf-preservers. Their names are legion, among them: DOE's John Huizenga and Will Happer, MIT's hot fusioneers Ronald Parker and Richard Petrasso, Caltech's Nathan Lewis and Steven Koonin, CERN's "pathological science expert" Douglas O. Morrison, Harwell Laboratory's (UK) David Williams, and physicist Frank Close, whose cold fusion history *Too Hot to Handle* was certainly not frank and wasn't even "close."

The media bought onto the opinion of this small but vociferous clique, and hasn't budged since. Just as NO scientific experiment, no matter how well done, nor how well-published is likely to change the paradigm paralyzed in the scientific establishment, nothing in our science is likely to convert the herd-mentality journalists. By and large these so-called science journalists have abandoned reason in favor of consulting the "priests of science," i.e. those well-ensconced in big Federal science programs and those at prestigious academic institutions.

Is there then any hope for a breakthrough from fiction to fact? Yes, indeed! But here is where *NOT* to look for it. Certainly, don't waste any time with Clinton, Dole, Perot or other politicians. They will do *nothing* for this field, as they have amply demonstrated these past seven years. Each of them knows *something* about this field—we know lots about what they know—but they'll all do nothing to rock the boat. (Of course, if they actually *did* do something, like simply *talk* about cold fusion, the DOE HeavyWatergate scandal, etc., we'd love it, but don't hold your breath.)

Is there any hope in DOE's leader Hazel O'Leary? Forget it—she's too busy taking junket trips around the world. Any hope for other federal bureaucrats? Never! We know lots of people in government agencies—in Massachusetts and in Washington—who like to have "fun" with cold fusion, but who fail to do anything to change agency policy. Some of these folks, in fact, want to "get a piece of the action" in the commercial cold fusion field, but are unwilling to demonstrate civic responsibility *within* their agencies. Sad, very sad. They should be raising hell!

Hope lies in only one direction: the introduction of commercial products. The stakes are very high. On the day that a bona fide self-sustaining cold

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bona fide self-sustaining cold fusion or new-energy system is marketed, is the day that the establishment view collapses in panic. On the *day* or *week* after one single mainstream magazine, TV network, or media channel testifies to the unambiguous reality of this commercial product, fossil fuel industry stocks will plunge—hopefully—to unheard-of lows. The ensuing economic panic will be the necessary price to be paid for seven years of neglect. It could have been otherwise, but it will not be. Instead of the gradual build-up to the commercial products—as could have happened if the scientific community had behaved responsibly, there will likely be "panic in-the streets." Certainly on Wall Street there will be panic. We'll leave it to your imagination what will happen soon after the low-energy transmutation of heavy elements gets talked about as the inevitable consequence of the Cold Fusion Victory. A gold panic? A precious metals panic? You bet!

Therein lies opportunity. Cold fusion and new energy investments are now HIGHLY undervalued. When the explosion of interest in these emerges after the introduction of the first commercial products, it will take a Ross Perot or Bill Gates to invest in the field (*Ross and Bill, better do it now!*) Now cold fusion and new energy investing can be the playground of the moderately rich. From $5 to $20 million invested *right now* in the U.S. in select U.S. and Japanese activities would have a dramatic effect. Those bold enough to seize the day and invest during this key window of opportunity could be richly rewarded. It does not take an economic genius to see that. During this critical transition time, every month that passes without investing makes future deals that much more expensive. On the "day after," well, Ross and Bill will know what to do!

The logic is very simple: (A) Cold fusion and new energy are real (though unexplained) and near-term marketable; (B) Cold fusion and new energy are *highly undervalued* (Thank you, Scientific Establishment!); (C) When commercial products emerge, demand for them and the complete conversion of the world's energy infrastructure will perhaps dwarf any market in history—the personal computer market will pale; (D) Ergo, those who invest now in a *multiplicity* of these technologies almost can't lose.

But where to invest, you ask? Check the pages of this magazine in coming months, or call us and we'll give you our best consulting advice—*not for free, mind you!* Please forgive us for charging for the experience, information, and insight hard won by battle scars in the "Cold Fusion War"!

The articles and briefs in this issue will, we trust, ratify what I have just said. Evidence builds that the Correa pulsed abnormal glow discharge device is real; read electrical engineer Mike Carrel's excellent investigation. This story is not going to go away. There is a forthcoming landmark low-energy transmutation meeting at College Station in Texas (see page 45). There, the cornucopia of transmuted heavy elements that have been confirmed within the metal layers of Patterson Power Cells will be revealed—and much else. Issue #9 of *IE* will have an extensive report on that meeting, which will be co-chaired by Professors John Bockris and George Miley (Editor of *Fusion Technology*). There are a host of other developments that we have covered in previous issues, all running parallel to this—more about them in future issues. Cheers!


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# LETTERS TO THE EDITOR

I have been actively engaged in energy research for nearly twenty five years. My primary area of interest is in "harvesting the Sun" by way of conversion of biomass to useable feedstocks for energy and chemicals.

With the assistance of Senator Pete Domenici, (a long time acquaintance of a colleague and myself) a Western Regional Biomass Authority that involves some 10 western states was established, with the intent of maintaining a stable agro base through use of biomass energy. Other such regions encompass other states.

Production of fuels and chemicals from agricultural crops and crop residues, although self-sufficient in principle, would be greatly benefitted by an inexpensive source of low grade process heat. For instance, the heat required for distillation of ethanol. There is a 10 million gal/year plant near Clovis, N.M. that has to use natural gas and/or coal for it's distillation heat.

The point is, with an inexpensive low grade heat source such as is promised by CF, agriculture could supply a goodly portion of the "petrochemical" feedstocks that are now coming from fossil fuels. This would be a boon to agriculture as well as the environment.

CF and Biomass would be a great combination. Two infinite energy sources.

Frederick Sparber
Belen, New Mexico

•

I remember the excitement that accompanied the release of the first personal computers in the late 70s, and I expect that the first "cold fusion" consumer products will generate even more excitement.

As an economist, I've been trying to think through the consequences of widespread super-inexpensive energy. Beyond the obvious lowering of the cost of electricity and fuel to a small fraction of current levels, this would eventually cut the cost of *everything* by a sizable amount, by nearly eliminating the cost of the energy used in production. In effect, it will make everyone richer, as well as having other beneficial social consequences.

Definitely something to look forward to.

Charles F. Barr
Las Vegas, Nevada

•

The The latest issue of *Infinite Energy* excited me to no end. Subscription to this magazine is the best investment a person can make. Keep up the good work.

Warner Frith
Little Rock, Arkansas

*Please tell President Clinton that when he visits his home town, I'm not sure he's reading his complimentary issues! —EFM*

•

I'm an electrical engineer, nuclear engineer, and technical writer. I've studied a great deal of modern nuclear theory....but WOW! HOLY @#@#@!!! I'm finding myself waking up at night dreaming of New Energy devices and disconnecting from my electric company ...*for good!* My wife thinks I'm over the edge...

I recently visited Malaysia for a month and took along all of the *IE* back issues on my bus rides all over the country. Fantastic reading! I discovered Bearden's article on a bus ride through the jungle to the island of Langkawi. It went right to my soul. I wish I could have enjoyed the scenery— it cost a fortune! But I was glued ....Maxwell's equations give up another secret!

I could not speak Malaysian nor Chinese, but everyone I could talk to was very interested in these developments. Most thought that *cold fusion* was dead....I set them straight on the new info and recommended your journal.

The era of PE "personal energy" may have arrived. I think the ZPF explanation will ultimately be closest to the answer. It is the most mind boggling, yet beautiful and simplifying answer.

Vince F. Golubic
US Army, White Sands Missile Range

•

*We are delighted to hear continuing reports that* Infinite Energy *is having such wide-ranging influence. —EFM*

•

Just got *IE*#7. Thanks for publishing my article. It looks better than I thought it would and mostly gets over what I wanted to say. I have now submitted a motion to Conference and it's being seconded by Guernsey (UK) Friends of the Earth —it's up to National FoE now whether they want this on the agenda. I'll keep you posted.

The text of the motion is as follows:

*This Conference notes the recent proliferation of reliable scientific evidence for the reality of "Cold Fusion" energy and many other similar devices. As they herald the rapid end of both the nuclear and fossil fueled industries, and hold out the prospect of cheap, abundant, pollution free energy, free from the control of individual nations or large corporations, they will obviously have a dramatic effect on most of our campaigning. This Conference calls upon the Board of Friends of the Earth to investigate the scientific reports, satisfy themselves as to the validity and potential of the new energy sources, and then to rewrite our basic campaign strategies to take the coming revolution in energy supply into account and, further, to actively promote the new devices as a solution to global warming and pollution. When these devices become mainstream we will be fully prepared to "hit the ground running.*

By the way, I'm no "hairshirt" environmentalist. If I can possibly work it, I'd like to invest a lot of money in these technologies. I'm planning to sell my house this year and have no immediate plans to buy another — that money will need to live somewhere for a while. Are any of the companies planning on getting stock market quotations yet? I see nothing wrong in getting richer whilst simultaneously helping to solve the world's energy supply and pollution problems —enlightened, profitable altruism

Nick Palmer
England

•

*Thank you, Nick! We only wish more of our potential allies in the "Green movement" would come forward, as you have.*


**••SPECIAL NOTICE••**

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*We are actively promoting the rapid commercialization of cold fusion and new energy. We want to see this technology in publicly traded companies ASAP! —EFM*

•

The latest *Infinite Energy* is SO GOOD, SO COMPREHENSIVE, SO EXCITING, SO ... well ... I can't find words to say what I feel. Let these suffice: THANK YOU. THANK YOU. THANK YOU.

Daniel E. Reynolds
Dayton, Ohio

*Thank* you, *thank* you, *thank* you! *Our cup runneth over.—EFM*

•

Please send me a copy of *The Quickening Universe*. I've read *Fire from Ice* with enthusiasm and now much appreciate your continuing work.

My wife and I just saw the movie, "Chain Reaction," and really enjoyed it, despite the local newspaper giving it only a two-star rating (on a five-star maximum scale) on the basis of "implausibility."

In the enclosed article, I'm amused that Seth Putterman at UCLA is hedging his bets with a neutron counter [during his sonoluminescence experiments]—just in case!

Willard D. Nelson
Olympia, Washington

I would like to endorse a recent movie to your readership. Enclosed is a Science/Physics article from *The Washington Post* (8-5-96) reviewing the content of the movie, *"Chain Reaction."*

To put it briefly, it is the first movie ever to mention and argue the topic of "Free Energy." Comparing it to the noble concept of "clean air," Morgan Freeman exhorts the viewers to consider what impact such an invention would have on the world economy, heavily dependent on oil.

The details about the invention's sonoluminesence are discussed in the *Post* article and in *Scientific American* (2/95). I am happy to see a suspenseful movie centered around energy, especially when the invention has some cutting edge technology.

What makes the movie even more timely is the event that occurred at the latest International Tesla Society conference (7/96) in Colorado Springs. When Dr. John Moreland tried to approach the stage to present his talk with Bruce Perrault, he was accosted by a man who eye-witnesses describe as a "CIA agent." The man grabbed John and tried one last time to discourage John from disclosing his findings about the use of alpha particle radiation to feed a resonant circuit, fashioned after the Moray device. Since John is a nuclear physicist specializing in nuclear medicine, I spent a few hours with him afterwards letting him convince me of his research findings. Recalling what happended to Paul Brown after the 1990 Tesla conference, when Paul disclosed his beta particle nuclear battery, fashioned after the Moray device, I believe that the movie "Chain Reaction" is worth studying for its political content.

The Moreland/Perrault device alleges 1-microwatt input with about 40 watts output, lighting a fluorescent tube.

Thomas Valone, P.E.
Licensed Professional Engineer
Integrity Research Institute
Washington, DC

*We thank Tom Valone for his timely report. Readers interested in Paul Brown's technology should consult the references in Moray King's "Super Tube" article in this issue of* IE. *We look forward to more reports from Tom on media and government happenings in "the world's most important city" (Their description, not ours—I'll take Bow and Concord, New Hampshire any day!)—EFM*

•

We are a high-school physics/engineering/everything club at http:// www.webcom.com/sknkwrks. We have done a pedal-power dry submarine, radiocontrol live-eye rockets, a 3-axis flight simulator, and many others.

We came across the premier-edition "Cold Fusion" [former magazine edited by E. Mallove] article by Dennis Cravens and were intrigued, but decided not to try to pursue it as a project.

We were looking for ideas for the next project when we came to the Correa article about pulsed plasmas in *IE#7*. First on page 14 we came to watt-hours referred to as power, but of course it's work. Then on page 18 the oxymoron "cold plasma." Then all the acronyms; XS NRG, PAGD, IVAD, LGEN. Heady stuff. The more we read, the more confusing it became, rather than less so. On page 20 are applications of electrical energy, as if people didn't know. On page 21 are some pie-in-the-sky applications of this yet-to-be-explained device. On page 36 there's reference to more "electricity" out than in. Is that current, voltage, work, power, charge? If your magazine is intended for the scientifically inclined, these references would be off-putting.

As we all read and reread, the consensus was that it seemed to be some kind of an electron pump/plasma switching device. Never is it clear how electronic switching becomes excess mechanical power in the transducer, the real power "where the rubber meets the road."

In our experience we have come to the conclusion that anyone who truly understands an invention can explain it in a straightforward way for the layman, in more detail for the engineer and in complete detail for the scientist. Someone who doesn't understand it will immediately throw technical-sounding "sci-cobabble" at the reader. That can mean "a little education" (was a dangerous thing), self-deception, or outright fraud.

In reference to the Newman engine on page 54, we're confronted with the coincidence of the right-hand rule for current, magnetic field and force on a wire matching the right-hand rule for rotational inertia. Never mind that if you're referring to electrons, the actual charge carriers, it becomes the left-hand rule. Also keep in mind that the magnetic field direction was arbitrarily assigned to go from N to S outside the magnet. And the "spin" of electons is a quantum quantity, not like a toy top's spin. It has no "non-quantum" reality, like "color" when referring to quarks.

Page 60 refers to a well-known peculiarity of the electric meter that some current/voltage phase relationships won't turn it, such as the old electric clocks, and not because they use such little power. Also frequencies higher than 60 cycles per second have a lesser effect.

Item 6 on page 60 shows a lack of basic understanding of electrical phenomena, denying what is measurable. Force IS proportional to current and voltage increases the current thru any resistance. And copper atoms don't move, "align" or release any energy when voltage is present.

I have been following science and technology for forty years. I would be the first to buy a fascinating gadget at Wal-Mart that would run forever driving a little fan with no energy input, replacing the lava lamp. When that day arrives, a new paradigm will be established.

Your vituperative attack on the patent office serves no useful purpose. By the degree of vehemence, it seems you are insecure in your own mind. If you know you're right, no setback will dissuade you. If you're wrong, no tirade will convince others.

True-believers need skeptics to keep their feet on the ground, like Republicans need Democrats. It's a damn shame, but that's the way it is!

Dave O'Neil (Republican)
Greenacres, Florida

*We appreciate David's frank letter—and his enthusiasm for hands-on science. We hope that electrical engineer Mike Carrell's article on the Correas' device in this issue of IE clears up many of the points he brings up. But for the record, it is our opinion, based on extensive investigation, that there is NO possiblity whatever that the Correas are trying to fool anybody! Furthermore, it is increasingly likely that their data is rock-solid and very well cross-checked.*

*As to our "vituperative attack" on the US Patent Office, we do not agree that it was vituperative. The US Patent Office continues to block numerous cold fusion patent*

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*applications based on references from biased and incompetent media articles dating back to 1989, fraudulent "null result" cold fusion calorimetry data generated at the MIT Plasma Fusion Center, negative books by "pathological skeptics," all the while ignoring or diminishing all published positive experiments. U.S. citizens have a right to be treated fairly in this critical process of review, and they have not been. There is much more to this story: you will read about it in the coming months. —EFM*

•

Henry Tannenbaum, an analytic chemist, said at the end of a television program on using trace mineral impurities in bullion for tracking down stolen gold that elements cannot be changed into other elements, so the "fingerprints" are foolproof, and he would like to hear from anyone who thinks they can transmute (other than by accelerators, etc). I wrote to the program to ask him to check into the results reported in *IE*.

*IE* is so crucial in bring about what free market forces seem to be having trouble doing. I cannot imagine how much strain you are facing, but the new technologies are more than promising, they are delivering. Bridging the credibility gap is very important right now and you do it better than anyone I've seen!

I want so much to have a demonstration OU device to demonstrate in my travels. I'm sure that some people wonder if I am a head-case, since I start so many conversations with the latest information about OU devices. I'll investigate the Newman videotape to see how likely it can be constructed in my humble mobile abode, but the Correa device seems most promising (but it's patented).

Hang in there!

Ed Wall
Ft. Worth, Texas

**USEFUL QUOTES**
**Compiled by Jed Rothwell**

"This work confirms the claims of Fleischmann, Pons, and Hawkins of the production of excess heat in deuterium-loaded palladium cathodes at levels too large for chemical transformation.....

"Although nuclear reaction products commensurate with the excess heat have not yet been observed, small but definite evidence of nuclear reactions have been detected at levels some 40 orders of magnitude greater than predicted by conventional nuclear theory."

***- McKubre, M. C. H., et al., Development of Advanced Concepts for Nuclear Processes in Deuterated Metals, EPRI TR-104195, August 1994.***

"The calorimetry conclusively shows excess energy was produced within the electrolytic cell over the period of the experiment. This amount, 50 kilojoules, is such that any chemical reaction would have been in near molar amounts to have produced the energy. Chemical analysis shows that no such chemical reactions occurred. The tritium results show that some form of nuclear reactions occurred during the experiment."

***- T. Lautzenhiser, D. Phelps, "Cold Fusion: Report on a Recent Amoco Experiment," Amoco Production Company, Report T-90-E-02, 90081ART0082, 19 March 1990***

" . . . we can say that anomalous nuclear reactions must occur in the electrochemical cells at room temperature."

***Y. Iwamura et al., Mitsubishi Heavy Industries, "Characteristic X-Ray and Neutron Emissions from Electrochemically Deuterated Palladium," ICCF5 paper # 312***

". . . excess power generation has been measured with high confidence level (99%). Taking into account the total excess energy generated (5,000,000 J), the following explanations have been eliminated (because their effect would be several orders of magnitude lower than what is observed): combustion of the hydrogen, combustion of silicon oil, reaction of hydrogen with materials in the reactor . . .

"This excess power is generated in a very specific way, the excess energy per atom of hydrogen being consistent for a given set of reactor conditions. The value of the energy is on the order of thousands of EV [per atom] . . ."

***- J. Dufour et al., Shell Research / CNAM, "Excess energy in the system Palladium/Hydrogen isotopes, Measurement of the excess energy per atom hydrogen," ICCF5 proc. p. 495.***

"Tritium up to 50 times background has been observed upon electrolyzing in 1N $D_2SO_4$ in four out of four cells . . . Maximum tritium concentrations of 8.9 x $10^{10}$ atoms/g Pd, 180 times the detection limit were found in the D-loaded Pd cathode, none in the H-loaded Pd. Also, no tritium within the detection limit was found 150 unused Pd pieces. Of these, 13 were cut randomly from the same wire spool as the four D-loaded Pd cathodes. The probability that the tritium in the latter was due to random spot contamination is computed as 1 in 2,380. It is concluded that the tritium was generated by nuclear reactions in the Pd."

***- F. G. Will, EPRI, "Tritium Generation in Palladium Cathodes with High Deuterium Loading," Trans. Fusion Technology, Vol. 26, Dec. 1994, p. 209***

"Over the past year we have been able to demonstrate that a plasma loading method produces an exciting and unexpected amount of tritium from small palladium wires. . . . By carefully controlling the sputtering rate of the wire, runs have extended to hundreds of hours allowing a significant amount (>10's nCi) of tritium to accumulate."

***- T. N. Claytor et al., Los Alamos, "Tritium Production from a Low Voltage Deuterium Discharge on Palladium and Other Metals," http://wwwnde.esa.lanl.gov/cf/tritweb.htm***

"Scientists in the field have gone to extremes in attempts to satisfy skeptics. Cells were stirred, blanks were done, extremely elaborate closed cell calorimeters have been developed (in which the effect has been demonstrated), the signal to noise ratio has been improved so that positive results can now be claimed at the 50 sigma level, the reproducibility issue has been laid to rest; but still it is not enough. I have heard some skeptics saying that a commercial product is the next hurdle to be jumped through before any significant funding can be justified. This is simply not right."

*- P. Hagelstein, MIT, "Summary Of The Third Annual Conference on Cold Fusion," Science forum, library 2.*


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• 2ND ANNOUNCEMENT •

# International Conference on Cold Fusion ICCF6

**Oct. 13-18, 1996 Hotel Apex Toya, Hokkaido, Japan**

**Sponsor: NEDO NEW ENERGY AND INDUSTRIAL TECHNOLOGY DEVELOPMENT ORGANIZATION**

## GENERAL INFORMATION

**Date:** October 13 (Sun.)— 18 (Fri.), 1996 **Venue:** Hotel Apex Toya, Hokkaido
**Official Language:** English
**Sponsored by:** New Energy and Industrial Technology Development Organization (NEDO)

## REGISTRATION

**• August 1, 1996 : Deadline for Final Registration and Deadline for Guaranteed Hotel Accommodation**

**• May 17, 1996 : Deadline for Submission of Abstracts**

## REGISTRATION FEES

The registration fee is (40,000 Yen) (includes a banquet and proceedings)
Accompanying person (15,000 Yen)
Student (Free — Registration must be accompanied by a letter of certification issued by the student's head or program director.)

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## WELCOME MESSAGE

We are pleased to announce that the Sixth International Conference on Cold Fusion (ICCF-6) will be held from October 13 (Sunday evening) to October 18 (Friday) 1996 at the Hotel Apex Toya, Hokkaido, Japan. Recent advances in very wide and intensive research from nuclear physics to materials science have made some scientific discussions possible on studies, which have long been neglected in these attractive fields. The purpose of this conference is to provide a forum for scientists involved in active researches on the subjects to interchange their ideas, present recent results, and consider the significance of these new results, demonstration, and development in the theory. We are looking forward to having discussions on these researches.

Chariman, Prof. M. Okamoto

## TOPICS

The conference will consist of invited (oral sessions) and contributed papers (poster sessions) on the following topics:

- Excess Energy Phenomena in Deuterium/Metal Systems (Experiments and Theory)
- Correlation Between Excess Energy and Nuclear Products (Experiments and Theory)
- Nuclear Physics Approaches (Experiments and Theory)
- Material Science Studies (Experiments and Theory)
- Innovative Approaches (Miscellaneous Phenomena)

## PAPERS and PROCEEDINGS

The ICCF-6 will include contributed and invited papers which will by presented in plenary, oral, and poster sessions. Papers to be presented will by from peers of the Program Committee and selected on the basis of submitted extended abstracts. The details on the extended abstract will be informed in the second announcement; call for paper. The final manuscripts will be published after a review by peers.

## TECHNICAL TOUR

A laboratory Tour to the Institute of Applied Energy New Hydrogen Energy Laboratory nearby in Sapporo City is planned for Friday, 18 October.

## SPECIAL INFORMATION

The local organization committee plans to support young researchers and students financially for the easier attendance to the conference.

## CONFERENCE LOCATION

The conference will be held at Hotel Apex, TOYA, Hokkaido which is located in an ideal position in Sikotsu-Toya National Park. The hotel provides a magnificent, 360 deg round view including Lake Toya. At Hotel Apex Toya, you can enjoy many hot springs, tennis courts and good golf courses. It will take about 1.5 hours by train from Shin-Chitose International Airport to the hotel. The participants will stay in the hotel throughout the conference period.

## CORRESPONDENCE

Please address all correspondence to:

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Tokyo 105, Japan.
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Fax: +81-3-3508-8902
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## CLIMATE AND CLOTHING

The average temperature in Hokkaido in October is 10.9 degrees centigrade (average maximum 15.7 °C and average minimum 6.0 °C). The average humidity is about 69%. Appropriate clothing includes top-coats, wool suits, sweaters, and jackets.

ICCF 6th. International Conference on Cold Fusion

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# CALENDAR

ICCF5 – Fifth International Conference on Cold Fusion
April 9-13, 1995
Monte Carlo, Monaco

Low-energy Transmutation Meeting (Private) At Texas A&M University
June 19, 1995

The 2nd World Hydrogen Summit
September 28
-October 1, 1995
Montreal, Quebec, Canada

16th Symposium on Fusion Engineering (SOFE '95), *with cold fusion component!*
October 1-5, 1995
Champaign, Illinois

Third Russian Conference on Cold Fusion and Nuclear Transmutation
October 1—8, 1995
Sochi, Russia

Power-Gen '95
(CETI cell demo)
Anaheim, California
December 5-7, 1995

New Ideas in Natural Sciences
June 17-22
St. Petersburg, Russia

1996 International World Energy System Conference
June 19-21, 1996
Toronto, Canada

2nd Low-Energy Transmutation Meeting
College Station, Texas
Sept.13-14, 1996

Sustainable Transportation—S/EV96
Sept. 16-18, 1996
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**(*Infinite Energy* Magazine has a booth at the trade show 9/17-18)**

ICCF6—Sixth International Conference on Cold Fusion
October 13-18, 1996
Hokkaido, Japan

ICCF7—Seventh International Conference on Cold Fusion
1997, autumn-winter
Scheduled for the U.S.


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# THE CORREA INVENTION

## An overview and an investigation in progress

by Michael Carrell

This is a follow-up to the feature story on the Correa Pulsed Abnormal Glow Discharge reactor in *Infinite Energy* #7. Because of time limitations, one patent and parts of another and a laboratory report by the Correas were published in that issue. The patents and report are informative, but require careful study to extract the data of most interest to readers of *Infinite Energy*. In preparing this article, the author had the benefit of several long conversations with Dr. Correa, access to the full text of three patents, and some recent data taken with digital instrumentation.

### What the Correa Reactor Does

The Correa's reactor produces short, repetitive pulses of electrical energy of multi-kilowatt magnitude which can be utilized to drive electric motors and charge batteries. The energy released is tens to hundreds of times that needed to excite the reactor. Sustained self-operation has been demonstrated.

In the course of development work on x-ray tubes, the Correas noticed some anomalous behavior in glow discharges. Further experimentation and literature search disclosed that under certain conditions, large bursts of energy are released in cold cathode discharge tubes. The bulk of the patents are devoted to means for reliably producing and enhancing the energy release, plus circuits for extracting and utilizing the energy. There are extensive and detailed test data, as well as a theoretical discussion.

### The Source of the Energy

There is no obvious source for the energy bursts observed. In one of the patents, the Correas state:

*Any apparent imbalance in the electrical energy input to the system and withdrawn from the system by the its operator must be considered in the context of the entire continuum in which the system operates, within which it is anticipated that accepted principles of energy balance will be maintained.*

In other words, the reactor is not a "perpetual motion" machine in a thermodynamically closed system -- which is impossible. It is, rather, an "open" system, open to the active vacuum, aether, ZPF, or whatever name will be given to the energetic substrate of the universe. Dr. Harold Aspden has devoted many years to the development of an alternative physics which is relevant to the Correa's invention as well as other developments of interest to readers of *IE* (see accompanying article).

### The Essential Phenomenon

The Correa's reactor is simple: a partially evacuated tube with two or three electrodes, as shown in Fig.1. The cathode area is large — 128 square cm in some test samples; the area of the anode and the probe are less important. Other electrode configurations, such as a cylindrical cathode with an axial anode, are possible. Electrode spacing from a few centimeters to 20 cm are useable.

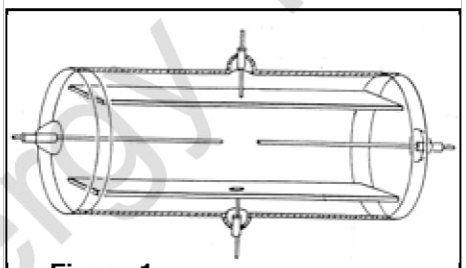

**Figure 1.**

Impressing several hundreds of volts between the anode and cathode sets up an electric field which will accelerate any stray electrons sufficiently to ionize gas molecules. Electrons, being negative, are attracted to the positively charged anode. The positive ions, are attracted to the negatively charge cathode, but being much heavier, move more slowly. Conventional discussions of the gas discharge phenomena focus on electron behavior. The phenomena in the Correa's reactor are much more complex and will be discussed below.

Limiting the current flow and allowing it to increase, while measuring the voltage across the reactor, produces the curve of Fig. 2, which illustrates typical behavior of the cold cathode discharge as it is generally understood. In regions where the voltage increases with current, the reactor exhibits positive resistance and its operating condition is stable. In regions where the voltage decreases with increasing current, the reactor exhibits negative resistance and is unstable.

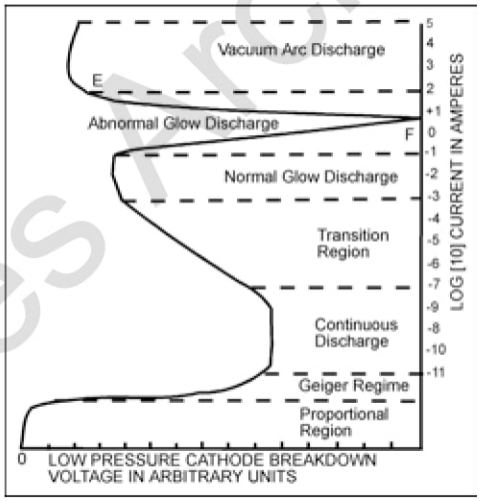


**Figure 2.**

In the Normal Glow Discharge region, the cathode becomes covered by a glow which is characteristic of the gas in the tube. This glow is commonly seen in neon indicator and decorative lamps; in the decorative lamps the current is limited so the glow does not cover the cathode and it flickers unstably.

When the current is allowed to increase, the glow covers the cathode, and then has nowhere to go. The voltage increases rapidly and the pinch effect begins to concentrate the ion flow into a smaller region. What usually happens is that the ion bombardment causes local thermionic heating of the cathode, releasing a flood of electrons and the glow collapses into the Vacuum Arc Discharge region. This is seen in fluorescent lamps, advertising signs, and high intensity flood lamps.

The Correa's patents show how to avoid the arc discharge and operate in the Abnormal Glow Discharge region, with currents in the range of 0.1-10 amperes. It is in the region from F to E that the Correas discovered the energy burst which is the foundation of their invention. With proper construction and operating conditions, the energy bursts are repetitive and self-extin-

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guishing and the reactor is quiescent between bursts

**This the Pulsed Abnormal Glow Discharge, PAGD.**

*Is There Anomalous Energy Production?*

The Correas present several kinds of evidence. Tests made with the circuit of Fig. 3 show that a PAGD reactor can charge batteries and run motors, using less energy from the exciting battery than is delivered to the loads.

There is, in addition, self-sustaining operation in which net energy is produced without external input.

**PAGD Utilization**

The PAGD energy burst is electrical, so means are necessary to set up the PAGD conditions and capture the burst energy for external utilization. The Correas have invented a number of electrical circuits of which Fig. 3 is representative, being used in the tests documented below.

A stable source of DC to set up the PAGD is provided by the Drive Pack (DP) battery with terminals A1 (+) and A2 (-). The current flowing from the Drive Pack is limited by the resistor R1. Diodes D1 and D4 prevent current from flowing into the Drive Pack from the energy burst in the PAGD reactor. Capacitors C3 and C5 couple the energy burst to the load while preventing any continuous discharge of the drive Pack into the load. Diodes D2, D3, D5, D6 comprise a full wave rectifier which charges capacitors C7a, C7b. Diodes D7 and D8 allow current to flow only into the Charge Pack battery, CP.

An auxiliary circuit containing an AC motor can also be driven by the PAGD reactor by closing switch S4 and choosing appropriate values for R4, C4, C8. Patent '391 has extensive information on test results with motors.

The reactor can be operated as a diode, or as a triode by closing switch S2.

Dr. Correa has furnished the author with several oscillograms taken with high performance digital instrumentation since the patents were filed. Three of these have been scanned and carefully traced using CorelDraw and reproduced as Fig. 4a,4b,4c. In these, Voltage In is across A1 and A2, and Current In is that going into A1. Similarly, Voltage Out is across E1, E2 and Current Out is into E2. The power curves were calculated for each sample from the raw data.

The sampling interval was 80 µs. Essentially, the energy burst charges C7a and C7b, which then discharge into the Charge Pack. Capacitors C3 and C5 reach full charge in about 3.2 ms, which suggest that the peak energy in the burst is much higher than shown in Fig. 4. When the reactor extinguishes at the end of 25 ms, charge stored in C7a and C7b transfers smoothly to the CP. The values for Coulombs of charge transferred and Joules of energy were obtained by careful reading and graphical integration of the original plots, which are detailed enough to show the values for each of the samples

Fig. 4 clearly shows substantial overunity performance. It also indicates the difficulties in study, documentation, and utilization of the PAGD phenomenon. The data of Fig. 4 are for one specific set of conditions, with a pulse rate of 0.5 pps. For higher rates, the peak values are less.

One develops a burning curiosity about the voltage and current waveforms at the reactor itself, but these, alas, remain the proprietary information of the Correas.

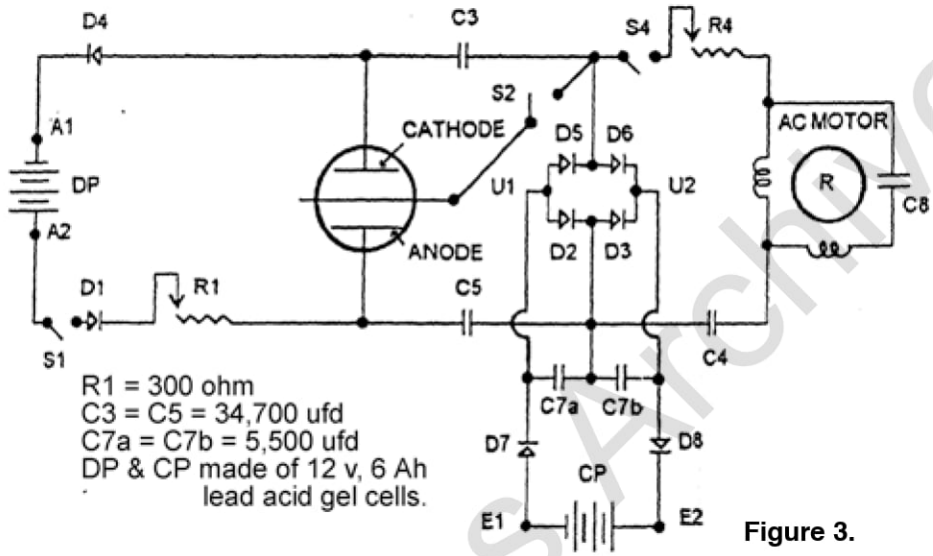


**Figure 3.**

**Measurements in the '989 Patent**

Without the present instrumentation, the energy bursts could be observed, but not directly measured. And for practical utilization, sustained runs were necessary. The Correas used calibrated batteries for the Drive and Charge Packs. (Newman cited the extended performance of batteries driving his Energy Machines as a proof of the unusual characteristics of his developments. Newman used primary cells,

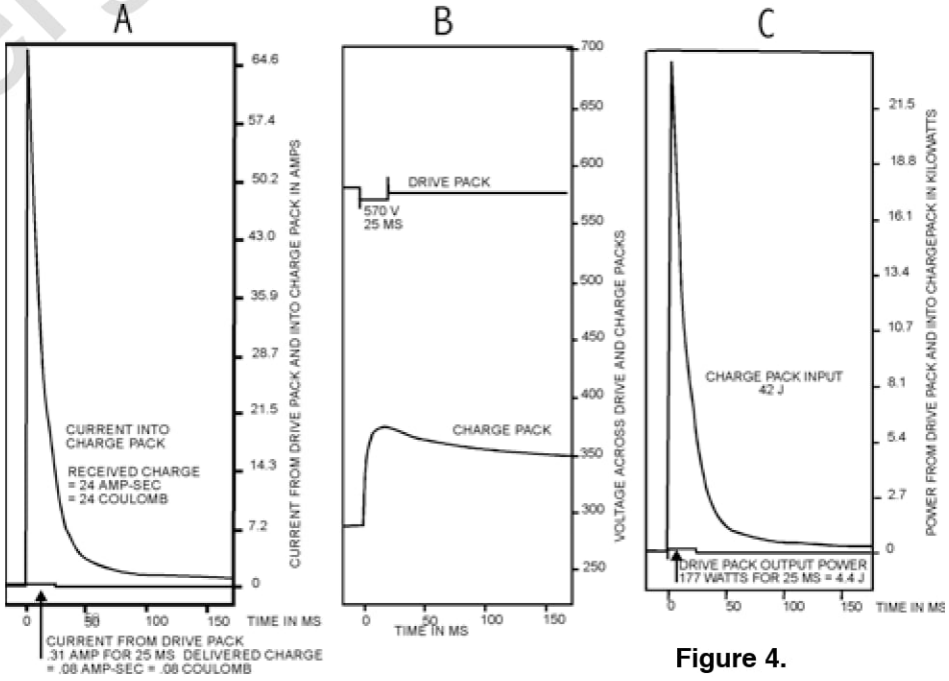


**Figure 4.**

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introducing many uncertainties in evaluating his results.)

The Correas are well aware of the problems in measuring energy with batteries. The '989 patent contains an extensive discussion of four different strategies and their weaknesses, resulting in an experimental protocol which is illustrated in Fig. 5. This illustration is a composite of scans of the patent illustrations, with some additions and changes to clarify the protocol.

Pre Charge: The Drive and Charge Packs consisting of 12 V, 6 Ah gel-cells, are each charged in a normal fashion. Full charge is taken as the point where the charge current drops to 25 ma. The Packs are are allowed to relax for a minimum period of 15 minutes, but extended for experimental convenience.

**Pre-Run Charge: The batteries are charged again as before.**

Pre-Run Discharge: The batteries are again partially discharged for over an hour, taking enough data points to establish each battery's characteristic against its immediately previous calibration.

Test Run: During the test run, the Drive Pack will lose energy and the Charge Pack will gain energy. The batteries are allowed 15 minutes to relax from the stress of discharging or charging.

Post-Run Discharge: The load resistors are again connected and voltage readings taken until the batteries' discharge characteristic tracks the previous calibration curve. It is then possible to estimate the energy lost by the Drive Pack and the energy gained by the Charge Pack, and calculate an efficiency as shown in Table 8 of the '989 patent. Fig. 5 is based on Run 3 of that table, and the battery calibration curves of Fig. 5a and 5c were taken the day before Run 3.

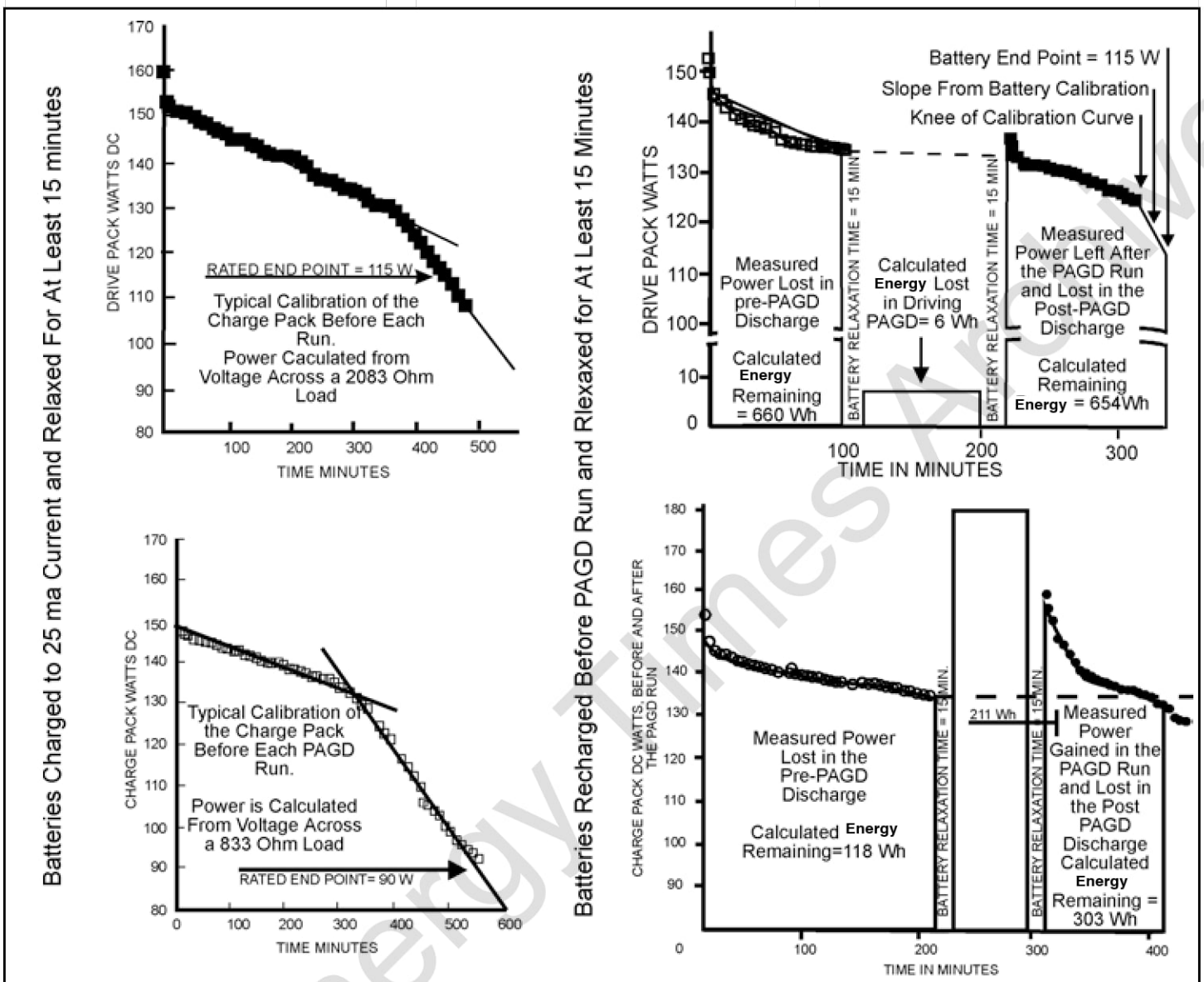


**Figure 5.**

One difficulty with the above protocol is that the measure of the energy loss of the Drive Pack amounts to the difference between large numbers, and appears in the denominator of the efficiency calculation. The result is thus vulnerable to measurement errors.

The presentation of data in Figs. 16 and 17 of the '989 patent has a number of difficulties, which become more apparent with careful examination. Indeed, sparing the reader that difficulty was the motive for reformatting the data as seen in Fig. 5.

A compensation for the need for elaborate calibration procedure is that the measurements are all DC, with no uncertainties from power factor, phase, and rise time as seen in Fig. 4.

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**"Videographic" Data**

Fig. 20 of the '989 patent shows battery power on a running sample basis. It is reproduced in simpler form as Fig. 6.

A bank of Beckman RMS multimeters were set up to measure the voltage across

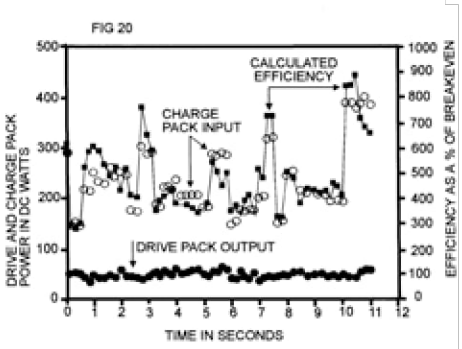


**Figure 6.**

and current through each Pack. The meters were then photographed with a video camera. Played back in a stop frame mode, it was possible to read the meters and perform power calculations at 1/30 second intervals. In Fig. 6, the points a the bottom, clumped into a irregular line, are the power input from the Drive Pack. The circles are power to the Charge Pack, and the black squares the calculated effiecieny for each set of measurements.

The Beckman multimeters utilize a RMS module from Analog Devices. The module contains a precision full-wave rectifier and a logarithmic squaring circuit, followed by a low-pass filter for averaging. The instrument will indicate true RMS within a range of input waveforms.

The illustrated tests were for Run 6, and the waveform data, it is probable that the Beckman multimeters were not giving accurate readings because of the low duty cycle of the pulses. The errors would affect the input and output measurements in similar ways, so Fig. 6 can be taken as an interesting illustration of another aspect of the over-unity performance of the PAGD reactor.

While there are a number of criticisms which could be made of one or another aspect of the protocols, a honest study of the patents will show a thorough awareness of the uncertainties in the use of batteries, and careful, systematic characterization of the batteries at hand.

**Self-sustaining Operation**

When discussing over-unity performance, endless measurement is no substitute for self-sustaining operation with no apparent external input. The Correas have achieved this with two PAGD reactors and a battery-swapping procedure. The circuit arrangement is given in the '989 patent, with a schematic summary in Fig. 7.

The Charge Pack must always be at a lower voltage than the Drive Pack. Two center-tapped battery packs are used. The full pack is used to drive the reactors, each of which charges half of the second pack. The roles are then switched.

In one test cited in the patent, the battery swapping was continued for eight hours, with both packs gaining charge. There was no external energy input. Dr. Correa indicated that this is done automatically in more recent implementations, not covered by the available patents.

*Is PAGD Just a Strobe Oscillator?*

The circuit of Fig. 3 bears a superficial resemblance to an ordinary strobe lamp, where a capacitor connected across a discharge tube is charged to the breakdown potential, initiating a Vacuum Arc

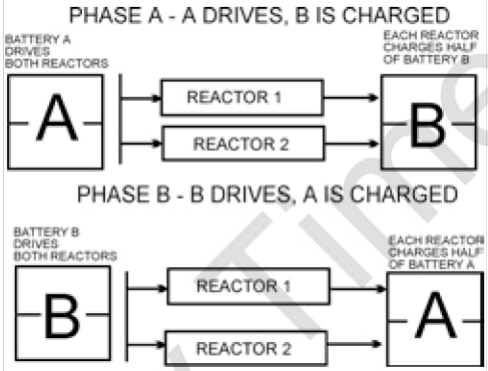


**Figure 7.**

Discharge in which the peak power can be very high. In the circuit shown current from the DP flows through, and charges, the CP as the capacitors C3, C5 are charged. When the discharge occurs, a portion of the charge in C3 and C5 is again transferred to the CP, by virtue of the full-wave rectifier D2, D3, D5, D6.

Considering this hypothesis, in a first approximation the voltage of CP opposes that of DP, and R1 is 300 ohms. Using voltages from the example in Fig. 5, the available charging current is (580-300) / 300 = .93 A. Using the 70 minute test run of Fig 6, about (.93)(300)(70) / 60 = 326 Wh would be transferred from DP to CP, which is greater than the 211 Wh calculated for the test illustrated in Fig.6. This hypothetical scenario would produce flashes in the reactor tube and charge the CP from the DP, but would not show over-unity performance.

**What Actually Happens in the PAGD Run**


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The author, Frank Znidarsic, has a B.S. in Electrical Engineering from the Unviersity of Pittsburgh, has an Associate in Science from Saint Francis College, and is a registered professional engineer in the state of Pennsylvania.

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Actual measurements of the current out of the DP and into the CP in Fig. 5A show that no current flows out of the DP or into the CP except from the PAGD energy pulses. In the hypothetical case proposed, an average current of .93 A should be seen flowing out of the DP at all times, and would be easily seen in the instrumentation plots.

What is seen is a current pulse of .31 A amplitude and 25 ms duration, coincident with the energy pulse in the reactor. In that same time period, a current pulse peaking over 65 A goes into the CP. At the end of the 25 ms pulse, the current out of the DP drops to background levels.

The hypothetical strobe oscillator mode described might occur in the absence of the specific conditions of the PAGD. However, in PAGD the energy eruption drives the nominal cathode both positive and negative, and may leave C3 and C5 temporarily charged so that D1 and D4 block current flow from DP.

Thus the hypothetical strobe lamp mode does not actually occur, and the evidence points to over-unity operation.

The PAGD phenomenon, with its energy yield, can be evoked without C3, C5 or any of the attached circuitry -- all of that was developed simply to couple the energy burst to useful external devices. What is essential is field-effect emission from the cathode.

**Comments on the PAGD Phenomenon**

The Abnormal Glow Discharge is well known, as are anomalous forces and energies associated with plasma discharges.

In 1969, Manuel patented a coating process utilizing the AGD, with external controls to prevent the AGD from entering the VAD region. It did not generate energy, nor were the pulses self-triggered.

The PAGD phenomenon is complex. In addition to ions and electrons originating in the gas, cold-cathode auto-electronic (field effect) emission from the cathode contributes a substantial electron flow. The ions are attracted to the cathode, and the electrons to the anode, but there is a third flow of atoms to the anode, effectively neutralized by the electron stream.

This third flow was observed ss far back as 1930, by Kobel and Tanberg in published reports on forces reacting on cathodes in Vacuum Arc Discharges in Physical Review. Tanberg measured a vapor velocity of 16 x $10^6$ cm/sec.

Aspden, in a paper *The Law of Electrodynamics* in the *Journal of the Franklin Institute* in 1969, notes that where charge carriers differ markedly in mass - as with ions and electrons in plasmas - very strong longitudinal forces can appear.

These ideas a developed more fully in a privately published **Energy Science Report No. 8, POWER FROM SPACE: THE CORREA INVENTION.** He proposes a radial separation between the ions and electrons at the cathode which sets up strains in the aether, releasing substantial energy.

Aspden's reasoning is consistent with the appearance of spherical or conical plasma balls on the cathode with each energy burst, shown in photographs in *IE #7*.

The cathode is eroded by the PAGD process, some portion of it being vaporized. In a sense the cathode material is a "fuel" consumed by the process. It is more likely that this is a result of the energy release, rather than the cause of it.

The cathode pits have been measured by Correa. The material removed is not adequate to produce charge carriers for the output current pulse.

In patent '391, the Correas refer to their reactor as a transducer of energy, which is an appropriate description. In the form illustrated in *IE #7*, the PAGD reactors are laboratory prototypes, built around 1992. Since then, significant advances have been made in smaller and larger configurations which address the cathode erosion problem to extend the working life of the devices.

A current development target is a reactor 80 cm. long, 10 cm. dia. with a power output of 5 kW and a operating life of 2-3 years. At present, the Correas are at about a 1 kW level. There is reason to believe that the reactors can be made smaller and the operating voltage reduced. They are having discussions with potential licensees.


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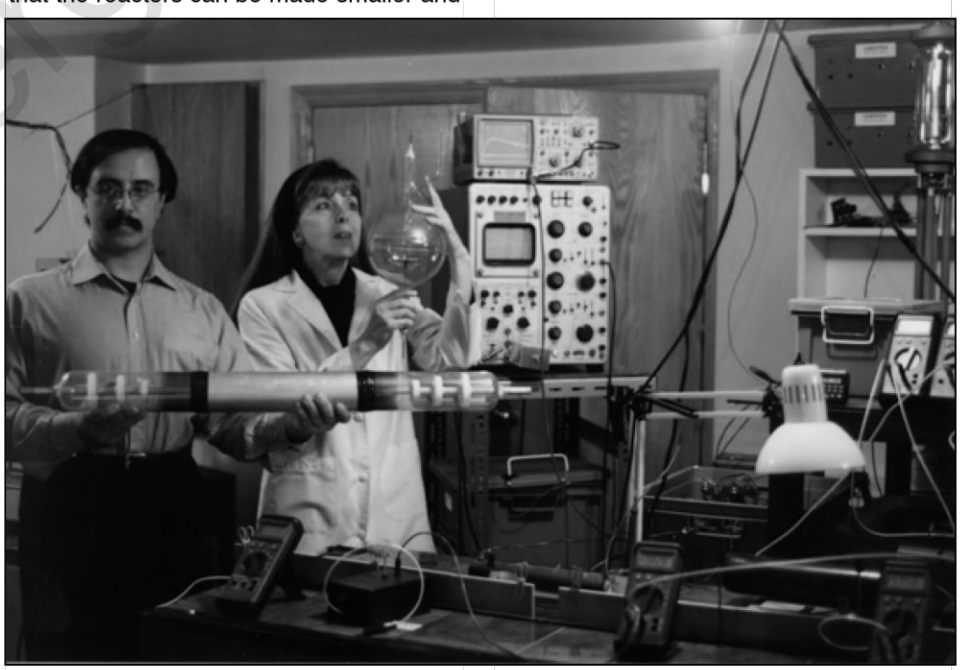
***The author wishes to thank Dr. Paulo Correa for extended and patient conversations, and reviewing this article before publication. His review does not constitute an endorsement; any errors remain the responsibility of the author. Thanks are also extended to Dr. Harold Aspden for making available certain of his reports and an out-of-print copy of a pioneering book.***

**Dr. Paulo and Alexandra Correa at Labofex holding PAGD reactors. (Second XS NRG™ system is on the right)** *Photo: Copyright 1996, Correa and Correa*

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# THE REALITY OF PERPETUAL MOTION

Dr. Harold Aspden (Copyright 1996)

**Introduction**

Having been appointed a new member of the Scientific Advisory Board of *Infinite Energy*, I have been asked by the Editor-in-Chief, Dr. Mallove, to submit an article "synthesizing from my previous work." That is a rather daunting task, but I will do my best here to provide a general outline of the theme I have followed over the years.

I will have much more of a specific nature to say quite soon in future writings, but think it best here to introduce how I view the "free energy" field.

Based on simple Newtonian mechanics, perpetual motion within a purely mechanical device is impossible. However, once one understands the true electrodynamic nature of the force of gravity and how interactions are set up which involve energy transfer between electric charges, then perpetual motion, subject to machine wear and tear, is just a matter of exercising one's ingenuity. This is because electric charges in motion interact as a function of motion relative to one another and by virtue of their interaction with the all-pervading sub-quantum medium that some call a frame of reference, but which we will here refer to by its proper name, the aether.

There are three ways in which one can contemplate building a "perpetual motion" machine, which is really what we are all talking about when we use terms such as "free energy." They are:

1. Build something you imagine might work and then pray for a miracle as you try to set it running.

2. Be attentive to claims made by others who say they have built something that does perform such a miracle and then try to replicate it from the gist of what you can find they have disclosed.

3. Study the detail of the mechanism of an existing very large perpetual motion machine, which you know does work and to which you have access, and see if, by first probing the physics of that mechanism, you can devise a way of tapping into its energy activity, just as the alternator draws electrical power from the engine in your automobile.

The middle course above is the one normally adopted and it has its excitement but is very frustrating. I have chosen the third track, and even though that has had its frustrations I have advanced relentlessly. I believe I now understand the physics needed to access that hidden energy and so can help to build the new energy technology.

If too many would-be venturers in this field go along that second track each travelling separately and they try to replicate what they think others may have done, a state of chaos can result. However, even amongst that chaos, which is now becoming so very active, we are witnessing a kind of clustering as order is beginning to emerge at certain focal points. Thus we see "cold fusion" or "plasma discharges" or "permanent magnet motors" as giving some of us the feeling that this is all real and that the era of new energy technology can now begin. There are still those, the vast community of scientists who sit on the side lines and watch, confident in their knowledge that all this effort is a waste of time. I say "watch," but it is more correct to say that they look the other way and avoid all thought of getting something for nothing, at least in the "free energy" sense.

My interest in this scenario has an unusual background. Being well brought up in the disciplines of science and engineering, I could never have dreamt that "perpetual motion" would be something I would ever write about, far less get involved in experimentally.

Indeed, my Ph.D. thesis was more concerned with the mysterious loss of energy that was observed in the electrical steels used in power transformers and in the alternators used to generate power.

I became interested career-wise in inventions and my knowledge of magnetism and its related technology was applied to secure patent protection for a major engineering company in U.K. before moving on to IBM at year-end 1959 as their U.K. Patent Manager. Then from 1963 to 1983 I was the director in charge of IBM's European Patent Operations.

I do not recall ever seeing an invention disclosure in IBM that could be classified as "perpetual motion," yet even in the 1960s IBM's patent function was processing several thousand invention disclosures per year. I remember, however, from my pre-IBM years discussing with an elderly German visitor his offer of a "free energ" machine. He declared it would replace the locomotive diesel engines manufactured at one of our plants. As his credentials he said he was chief engineer involved in U-boat design during World War II and then surprised me My saying, "You know Albert Einstein?," then allowing me a very brief glance at a letter addressed to him and signed by Einstein. He followed that by letters from Max Planck and Werner Heisenberg and thereafter went into a display of copious design details of thrust forces in a closed cycle gas turbine having no fuel input.

When I later studied his calculations I found that he had omitted the reaction forces which arise when gas goes around a bend and had only worked out the axial forces on the compression and expansion sets of turbine blades in his proposed engine. He had in fact not done a full analysis and was in breach of Newton's third law of motion, concluding that action and reaction were not in balance. He was wise enough to know that if one can breach that law then one can contemplate the perpetual motion machine.

I was, in those days, part of the conventional world that knows that "perpetual motion" is impossible, but, unlike many in that world, I was attentive to alternative opinion. On the pure science front, as opposed to engineering proper, I was already rebelling against the Einstein philosophy, which ran contrary to my research findings on magnetism. I must say that, in view of that scientific interest, the names Einstein, Planck and Heisenberg made that little episode of the mid-1950 era stick in my memory. I did know enough German to know whether those letters were supportive, but was not allowed to read anything other than the signature, so you can draw the appropriate conclusion.

**IBM Glueballs and Patent Power**

I have said above that, as far as I remember, IBM did not process any invention disclosures related to "perpetual motion" and I now mention two news items from the Spring 1966 issue of "Helpware" sent to me by IBM. They read:

**Patent Power:** IBM has topped the US patents table for the third year running. With a record 1,383 patents in 1995, IBM received 27% more patents than any other company.

**Glueballs:** Quarks have strangeness and charm, but IBM has glueballs. Three IBM scientists working on the fundamental properties of matter have figured out the properties of the things that stick all the other particles together.

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The latter item made me wonder if "glueballs" could have something to do with "cold fusion," because "glue" has its hot and cold forms and there was a time when hot bonding techniques were used in manufacture, whereas today we also see cold-bonded resin technology.

IBM has doubled its patent filing rate since the 1960s and I wonder how many of those 1,383 US patents granted in 1995 are beginning to touch that forbidden boundary which we see blocking the field of "cold fusion"? There will surely be some that are invasive and traverse the boundary set by the second law of thermodynamics, as I will explain below when I refer to superconductivity.

As a European Patent Attorney, I was well aware of the facts of patent law which declare, unambiguously, that an invention must be capable of industrial application. Under this heading comes the issue of "perpetual motion."

Inventions are excluded from patentability if the article or process is alleged to operate in a manner clearly contrary to well-established physical laws, a specific example being a "perpetual motion machine."

Patent law is applied to reject such inventions by the use of a double-barrel gun. The Patent Examiner fires the first barrel if the claim specifies the intended function or purpose of the machine to be the generation of that "free energy" we talk about. The second barrel is fired if the claim does not declare the intended function and merely specifies the construction of the machine, it being implicit somewhere in the specification that the objective really is to cover a "perpetual motion" machine.

We therefore confront the chicken-and-egg argument of which comes first, (a) demonstrating actual industrial application of a technology that can be categorized as based on "perpetual motion" inventions so as then to contest a change of patent law or (b) getting scientists to accept that some of their "well established physical laws" are open to challenge and so can become disestablished. Without patent protection, R&D funding is not forthcoming. Even investors not interested in patents will not rely on what they see might work. They cover themselves and their co-investors by taking independent scientific advice, and that implies need for demonstration of a fully tested operable machine, which then takes us back to square one.

I retired early from IBM in 1983, expressly to get back to university and continue my private research on the third track introduced above. I had no idea in 1983 that IBM would later take up research aimed at calculating the masses of protons and neutrons, a subject I had written about years before at some length.

You see, if we can understand how protons are created we can understand how energy was shed to create the universe. If that understanding shows us that energy radiated into space can be absorbed, stored for a while and then, by some statistical pattern of events, remoulded into protons, we have an insight into the operation of that perpetual motion machine we inhabit and which we call the "universe."

From 1952 onwards I had been dissecting and probing the operating system inside that perpetual motion machine, the aether that pervades the universe, recognizing that it had a demonstration model of itself locked in the domain structures we see inside iron crystals and other ferromagnetic substances.

**'Free Energy': 1988 and Before**

It was in 1988 that I switched to that second track, knowing enough by then of what I needed to know about Nature's own perpetual motion machine. That was just before the discovery of "cold fusion," but just after the discovery of "warm superconductivity."

1988 was a year in which a paper of mine entitled "The Proton Factor and its Unknown Effects" was published. Readers of *Infinite Energy* (March-April 1996 issue No. 7) may have noticed a letter by Dr. Paul E. Rowe on p.6 in which he refers to the aether as a source of energy. The writing of that 1988 paper of mine was inspired by the experimental discoveries of Dr. Rowe concerning his finding that protons were actually being created in high energy electrical discharges in his gas discharge tubes. Here, at last, was some practical evidence that seemed highly relevant to my theory of proton creation. (*See also Dr. Rowe's article in this issue.*)

Dr. Rowe's research was showing that high voltage discharges can add hydrogen into the gas in the discharge tube and it seemed not to originate in hydride decomposition of the electrodes. If the discharge meant that the aether was disturbed in a way which made it shed energy then the options are "excess heat," anomalous electrical EMFs in the electrode circuit , and/or creation of matter (hydrogen). I was interested in all this, but my main interest was the creation of protons from aether energy.

Meanwhile IBM scientists, in 1985, had announced that they had put together at their Yorktown Research Laboratory their GF11 parallel computer using 576 floating point processors to engage in the largest computing task ever confronting a physicist, that of calculating the mass of the pro-


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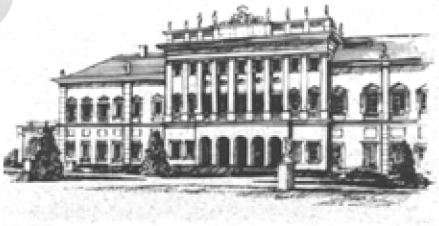

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ton and the deuteron. So far as I know, it is still working on that problem. Yet ten years earlier I had been co-author on a paper published in the mainstream literature which deduced the proton-electron mass [ratio] as being 1836.152 and, in the event, the leading scientists later measuring the proton-electron mass ratio to very high precision declared:

"The value that they (Aspden and Eagles) calculate is remarkably close to our experimental value. This is even more curious when one notes that they published this result several years before direct precision measurements of this ratio had begun."

It was "curious" because of the method used, which relied on energy in an aether ever-striving to create protons and only winning if it had spare energy to shed from its equilibrium requirements. The word "aether" was something one normally did not mention in a scientific paper appearing in a mainstream physics journal. So the "curious" note implies that information based on aether theory is something one should look for in the "Old Curiosity Shop." [It is in London, not too far from Chancery Lane and the Patent Office Library, the latter being a better search place for aethereal curiosity.]

Other IBM scientists working in their research facility on the outskirts of Zurich in Switzerland were studying the electrical conducting properties of perovskites and, as we know, that led to the technology of "warm superconductivity." Here in fact was a breakthrough into the "free energy" world, though it was not seen as such at the time.

One can, of course, patent chemical compositions which display unexpected properties having useful industrial application. One can do that even though what is involved seems contrary to well established physical law. Whatever happened to Ohm's law? "Warm superconductivity" defies that law.

I authored a book entitled *Physics without Einstein* and published in 1969. It explained the nature of the neutron and deuteron, as well as pointing out that there is no neutron in the deuteron, but it also explained that a magnetic field acting on a metal locks the energy of that field into a thermodynamic reacting state inside that metal. The book was read by Dr. Jaggi, an IBM scientist at that Zurich laboratory and, on one of my visits, he drew my attention to his experimental discovery, also published in 1969. He had found that there was a curious saturation condition and size-dependent non-ohmic behaviour occurring in germanium and silicon when the magnetic energy equated to kinetic energy within the conductor. See page 124 of my 1972 book *Modern Aether Science*.

The point I am making is that when warm superconductivity was discovered the scientific world should have realised that energy shed as heat owing to ohmic resistance loss has a way of regenerating electricity in the metal!

I did not know that when I did my own Ph.D. research and discovered that the eddy-current losses in electrical sheet steels could, at certain stages in the B-H magnetization cycle, be as much as six times greater than theory predicted. What I did not then realise was that **the energy shed as heat was regenerating EMFs which enhanced the current to levels far above the normal ohmic value.** In short, what I am saying is that the power transformers in use today, though very efficient, are not as efficient as our natural physical laws say they should be, simply because they are doing what physicists say is impossible and regenerating electrical power from the heat they shed.

Ask yourself: "How can the eddy-currents in electrical sheet steel ever be 6 times greater than they should be according to the rigorous calculations which all academic electrical engineers learn about to pass their university examinations?" Later independent reports of measurements made with the magnetization at 90° to the direction in which the electrical sheet steel had been rolled showed a 10-fold energy loss over theoretical prediction! The latter is textbook fact of some 30 years ago, but facts reporting experimental findings that have no explanation unless we accept the "impossible." There is regeneration of electricity from heat, in defiance of the second law of thermodynamics!

What I see in the discovery of "warm superconductivity" is the corresponding discovery that heat released by ohmic heating regenerates EMFs in certain materials having an appropriately tuned response.

I am now saying that by understanding this fully we can break through new energy technology barriers and develop efficient ways of converting low grade heat into electricity in breach of the second law of thermodynamics.

**Space, the Vacuum, its Anisotropy and its Energy**

It was on pages 29 and 30 of my book *Physics without Einstein* that I declared it might be possible to pump energy from the aether. The proposal involved a very powerful magnetic field such as can now be set up by a superconductive solenoid and it involved a ferromagnetic core. It was based on theory which some scientific critics then rubbished by declaring that space would need to reveal a preferred magnetic axis, which they said would have been discovered if it existed. I now draw attention to the item "Testing Over-Unity Devices in Germany" on p. 7 of the March-April 1996 No.7 issue of *Infinite Energy*, in which we were told that high ranking authority in Germany was now ready to move forward and pay serious attention to what might be offered on the "free energy" front. Professor Gruber received a response to this from an institutional source in Moscow. It was from Yu. A. Baurov, declaring that an engine running on physical vacuum energy has been developed and tested with a "free energy" output of 0.5 kW. As back-up information Baurov refers in that communication to his co-authored paper in *Physics Letters A*, 162, pp. 32-34 (1992) entitled "Experimental Observation of Space Magnetic Anisotropy." The paper says that experiments in which test bodies are suspended in a superconductive solenoid display a preferred magnetic direction in space. The level of magnetic induction used is that we see in ferromagnetic materials.

Here is evidence of an aether that can do work, an aether which fits my theoretical prediction, the same aether that creates protons. And I had good insight into its way of working, because I had decoded how it determines the proton-electron mass ratio.

However, the shattering effect of the dawn of "cold fusion" made 1989 the year when interest in the new energy field escalated. I was interested immediately, owing to my commitment to a theory which was based on proton creation and deuteron formation without neutrons. I was interested because I was already involved in energy anomalies in metal. I was interested because I had written about anomalous forces acting on cathodes in discharge devices.

Indeed, I was interested enough to file patent applications on "cold fusion," securing patent grant in U.K. but was soon to realise that I was up against a Patent Examiner who reads the *Wall Street Journal* and, if the *Wall Street Journal* says that cold fusion is a non-runner then the US Patent Office bows to that superior authority! I am being a little cynical here, but have noticed the "More Garbage from the U.S. Patent Office" item on p. 60 of the March-April 1996 No. 7 issue of *Infinite Energy* and, well, I will not comment further at this time, save to say that the *Wall Street Journal* will be appropriately authoritative in duly reporting the eventual business success in Japan as "free energy" takes off.

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**The Secret of the Creative Vacuum**

1989 was also a year in which a book entitled *The Secret of the Creative Vacuum* by John Davidson was published. That book, now in its second printing and soon to appear in a German translation, was too early to refer to "cold fusion," but it well reflects the status of the "free energy" theme at that time. The caption under the title was "Man and the Energy Dance" and that is very apt because, when we shed energy as waste heat and it is radiated away into space, the sub-quantum aetherial world is, in fact, engaged in a kind of rhythmic waltz and that spent energy is captured and obliged to join in the rhythm of the dance. Order comes from chaos and from that order energy can be packaged into proton-electron form or even released by ferromagnetism or gravitation, the dance formation being quantized in its waltzing energy pattern and the latter all being 'phase-locked' to its universal rhythm.

So, in 1989 I read pp. 245-259 in Davidson's book which refers to the spiral-turbine experiments of Viktor Schauberger. I could not believe what I read:

"If water is rotated into a twisting form of oscillation a build up of energy results, which with immense power can cause levitation..."

I could believe what John Davidson wrote on page 255:

"Looking at things from first principles, we have to understand that motion is the essence of manifestation. Everything we perceive is an energy dance. At the physical level this subatomic dance is spun out of the energy of space or the vacuum state energy field. And the nature of the motion of these spinning, whirling energy vortices, which we call subatomic particles, is of the utmost importance, for it is a patter which gives rise to all the macroscopic forms we perceive with our senses and allied instrumentation."

Now, a physicist or engineer not tuned in to the "free energy" scenario will see this as mere words with no scientific logic. I was not fully "tuned-in" in 1989, but was attentive. I can now see that by centrifuging water, which comprises positive hydronium ions $H_30^+$ and negative hydroxyl ions $OH^-$, one can separate the ions slightly and set up a radial electric field about a spin axis. You will presently see why this is relevant to the generation of "free energy," though I am still thinking about the anti-gravity aspect.

Reverting to the task of "converting" the scientific community so that that barrier of "well established physical law" does not unduly obstruct the scope for securing patent grant, I note that there are only three physical laws that we need to consider. The first law of thermodynamics, otherwise known as the law of conservation of energy, is well-established and cannot be breached. It was well-established at the time scientists believed in the existence of an aether. Energy is conserved in all exchanges between matter and the aether. I cannot recall any part of my university education when I might have been told that magnetic field energy, which I knew could be stored in a vacuum, was something that escaped the law of conservation of energy. Whether one uses the word "field" or "aether" one is talking generally about the same substance. However, a "field" cannot be a substitute for the "aether," because a "field" is a vector and "field energy" is a scalar, whereas the "aether" is that something in the vacuum that organizes itself to accommodate that energy— and there is far more energy in it than is explicable by our perception of "field" effects in the laboratory.

Today there is a foolish sector of the scientific community living in an imaginary world of virtual reality and unable to see an aether in their 4-space picture. Their opinions can carry no weight in the evaluation of the physics of "free energy." We conserve energy when it is transferred between aether and matter! One cannot "establish" a physical law at a time when everyone believed in the aether and then change its territorial jusridiction without revising that law. Take away the aether and the law is no longer valid!

I have heard it said that if the aether were to create energy on its own account it would go out of control and we would all be blown up. The simple answer is that it is already in equilibrium with matter but protons, believe it or not, decay to shed their energy which then feeds the aether with a surplus from which it recreates new protons. All we have to do is to stick our finger in the pie while this ongoing cycle of events takes place and capture energy that has climbed to a higher potential but do that before it gets back to the proton creation stage. See my above and later references to "phase locking."

**Laws and More Laws**

Secondly, there is the second law of thermodynamics. This is well established and cannot be breached so long as one keeps within its limitations. It concerns heat engines, as such, by which is meant engines that run on heat as fuel. Heat goes in at one temperature and comes out at a lower temperature, doing mechanical work en route. There are two temperatures. Gas molecules have a temperature according to their kinetic (mechanical) activity. What may I ask is the temperature of a photon? Indeed, what is the temperature of electricity? What is the temperature of magnetism? You see, if I can input heat at one temperature and it is transported through metal by electrons subjected to a magnetic field, I can divert those electrons off course and tap some of that heat to generate electricity. Now ask yourself a simple question. Is this a heat engine? Does the fuel (the heat) have a temperature? Does the working substance heated by that fuel all flow out, as in a heat engine, through the one exhaust at a low temperature? Well, no, because there is something different here. We are not talking about the MHD (Magneto-Hydro-Dynamic) technology of the 1960s, where as many atoms of gas emerge as output as enter as input. Those electrons in the metal do not really all flow from the hot temperature input to the cold temperature output. If they did they would carry current along with the heat flowing through a metal conductor and we do not see such a flow of electricity. The metal subjected to that magnetic field has a way of developing the electric power output transverse to the heat flow, without demanding any net electric current flow along the heat path. So, I say I know how to build a device for converting heat into energy without it being a heat engine within the scope of the second law of thermodynamics. It is bound by the first law only. I know this because I am a co-inventor of a device which generates electricity from melting ice placed on its top heat sink surface and then freezes water on that same surface when fed with a.c. electrical power input.

I note that if one can build two devices, one which defies the second law of thermodynamics and can convert heat into electricity with an efficiency much greater than the Carnot level set by that second law and couple that with a conventional heat pump complying with that law, then, in their back-to-back operation, one has not only a free energy generator, but refrigeration as well. The aether is not involved in this technology, which requires little more than a laminated assembly of thin films of nickel interleaved with a suitable dielectric material. My reports on that technology will soon be issued so I will say no more here.

The third law considered is not the third law of thermodynamics, which relates to the impossibility of cooling matter down to absolute zero of temperature in one action cycle. That law is connected with the name Nernst and textbooks on thermoelectricity term the effect described above as the *Nernst effect*. However, it needs a good measure of ingenuity to apply the Nernst effect to practical technology, but such

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technology is now in sight.

No, the third law I mention is the law of electrodynamics, which I see as the basis for Newton's third law of motion, but if I delve into that then this article will become too long and I must now curtail my commentary somewhat.

**The "Fairyland World" of "Free Energy"**

Before I conclude, I want to refer to the cover article of the March-April 1996 No. 7 issue of *Infinite Energy*, the article on the Correa technology, and to introduce a book I have just published entitled *Aether Science Papers*.

In publishing a work under this title I am redeeming a promise I made to myself when I stated on the back cover of my book *Modern Aether Science*:

"A mathematical extension of the new ideas presented in this work will be published separately under the title of *Aether Science Papers* and will be available from the same publishers."

That promise is redeemed after 24 years. The reason for this delay is the fact that that 1972 book was branded *Physics in Fairyland* by a key reviewer. That "fairyland" world is now our "free energy" world.

It was on page 67 that I quoted Dirac as declaring that the universe may contain as many negative protons as positive protons and as many negative electrons as positive electrons, it being all a question of which stellar domain regions were considered. We happen to belong to a region with positive protons and negative electrons. On pages 44-45 I quoted a French cosmologist Alexandre Veronnet as presenting a vision of the aether which warranted attention, owing to its connection with magnetism and in particular the unit we term the Bohr magneton which gave the aether a quantum feature and provided the link with ferromagnetism that I exploited. This was no "fairyland" but it was a world of energy filling space, and I was explaining how the universe was created from that energy.

More important, at the end of my book I urged that attention should be paid to an experiment performed by H.A. Wilson which bears upon our "free energy" interest.

It had been suggested that a body in rotation might develop a magnetic field as a gravitational phenomenon. It had come to be known as the Schuster-Wilson hypothesis. If the mass of a body is multiplied by the square root of the constant of gravity and the result is assumed to be the measure of electric charge, that body in rotation should develop a magnetic field. This idea worked qualitatively and quantitatively using data for the two bodies, our Earth and the Sun. So Wilson set about experimenting. He found magnetic fields induced in this way in iron and could not get rid of them, suggesting therefore that here was something very fundamental.

That dates from 1923, but eventually in 1947, the year before he won his Nobel Prize, Blackett drew attention to the fact that the Schuster-Wilson hypothesis applied equally well to a star some ten billion times more massive than the earth. He then set about trying to test the hypothesis in a laboratory, this time by contriving to use a very large gold cylinder which was located in a shed in a remote location. He sought to measure the magnetism seated in this gold cylinder as induced solely by its rotation with the earth. This required an enormously sensitive magnetometer, but the tests proved negative and so the Schuster-Wilson hypothesis stood rejected.

Now, when my aether theory showed me how rotating aether sets up a magnetic field I found that, if one assumed aether coextensive with the earth was rotating with it, then it gave the correct value for the geomagnetic moment. I knew then why the Blackett experiment had not worked. He had used an object which concentrates mass but not one that concentrates aether. In short, as the aether must extend to ionospheric altitudes and so pervade our atmosphere above ground, the gold cylinder would reveal no change of magnetic field by its presence or absence at the test location.

The aether was, however, seen by that critic who reviewed my book as something one could only relate to "fairyland." So, I will now come directly to the point of all this by declaring that the aether is "phase locked," which means that if we try to rotate a sphere of aether there will be constraints asserted upon that spherical form. These constraints are asserted by the enveloping aether owing to that "phase locking." Analysis shows that this will develop a radial electric field centred on the spin axis. Conversely, if we can set up a radial electric field about an axis of spin, then the aether coextensive with the range of that field will develop a spin. Since this comes about by a constraint asserted from that enveloping aether environment, the latter must contribute the energy needed to keep that "phase lock" condition. So, for every joule put in as electric field energy to set up the spin, the aether delivers one additional joule as kinetic energy. That is the source of the "free energy" I see at work in the Correa technology.

Can you now see why I referred above to the findings of Viktor Schauberger? By setting up that centrifugal separation of positive and negative ions in water he was setting up a radial electric field about the spin axis. There would be an inflow of free energy and if pockets of air in the pipework he used could make that flow pulsate in some way, setting up oscillatory effects, then that "free energy" could be replenished over and over again.

As to how stars get their magnetic field, the answer is that there was a cooling down of aether activity which allowed the aether to crystallize into a form that introduced gravitation. As in a ferromagnet, when cooled through the Curie temperature, domains form as magnetism appears. The corresponding phenomenon in the aether is what we term gravitation. The protons that existed could then coalesce under gravity and, owing to their mutual gravitational attraction giving an acceleration 1836 times that set up between electrons, the initial state of stars thus nucleated would have a positive charge. This set up the radial electric field as powered by gravitational energy. The radial electric field in turn induced the spin condition of the aether, further powered directly by aether energy, which eventually transfers to the matter in the star, but which also sets up the star's magnetic field.

In my book *Modern Aether Science* I related this to the creation of thunderballs by lightning discharges, because a discharge that concentrates positive ions (as in the Correa technology or in the discharges of Rowe's experiments) must develop radial electric fields. We get inflow of "free energy" supplied by the aether. That materializes either in a useful form or, as in the thunderball (or even the tornado), in a form that can be quite destructive. Yet all this is said to be "Physics in Fairyland."

In the case of the homopolar machine with a permanent magnet rotating to induce EMFs in a cylindrical disk, we have exactly the same scenario. The "free energy" potential is there but we have to know how to extract the energy, as by setting up pulsations. In a practical "free energy" device, one needs to recover the priming energy of 1 joule for every "free energy" joule delivered by the aether as a dividend. The energy capital invested has to be deposited and withdrawn repeatedly because the pay-off is a one-shot response which doubles the investment each time the radial field is reestablished.

This applies to the "aether spin" method of tapping that "free energy," as in the Correa apparatus where capacitative components have a feedback role, a 5:1 power gain in the device itself then being feasible. Once external storage and feedback is

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provided with this technology to close the loop, a power gain factor of this kind will not be of overall relevance. It will simply be a question of the amount of start-up power input needed and its limited duration to set the system in operation and then the performance will be judged by the specification of its continuous power output.

**The Aether, "Cold Fusion" and the "Supergraviton"**

As already indicated, the aether can shed energy by creating protons, but whether this may have practical consequences remains a matter for speculation. In the meantime, the "cold fusion" theme is of primary interest. Aether theory concerns also the creation of neutrons and deuterons and can help to explain the absence of neutrons in the fusion reaction.

It seems, furthermore, that the aether will shed energy in responding to electrodynamic action by an action quite distinct from that associated with a radial electric field. The latter transfers angular momentum and related energy from the aether, but the electrodynamic reaction induces the precisely opposite response. In responding to electrodynamic interaction between two charges in motion, the aether will not develop an out-of-balance reaction as a couple or turning moment. It can, however, develop an out-of-balance linear force, which means a breach of Newton's third law of motion, coupled with the delivery of "free energy" from the aether. This accounts for the anomalous cold-cathode reaction forces found in the researches of Correa and others, but these forces do useful work in compressing positive ions into a plasma ball which then can set up the radial electric fields which tap the primary input of energy from the aether.

Then there is the still undeveloped physics of magnetic actions in metals which offers enormous promise for the "free energy" theme. There are ways of setting up non-linear electric field gradients inside a metal, given the trigger of an initial temperature gradient. Such a gradient means that sources of electric charge originate inside the metal. In other words a surplus of negative charge can exist and yet not be detected. A surplus of electron charge in a metal, and sitting amongst free protons or deuterons which are free to migrate inside the cathode and so are subject to the anomalous electrodynamic forces accounting for coldcathode reactions as just mentioned, can draw on aether energy. Such forces are accentuated and escalate in strength if the mass of the interacting charges differ, which is the case once we consider migrant protons or deuterons. That can trigger the merger of two deuterons, because the electrons are in surplus and an unexpected energy fluctuation is at hand. We may then see the makings of a fusion reaction resulting in excess heat.

In deliberating on this scenario, I have also to consider the involvement of the "supergraviton." My theory explains gravitation but requires the presence of a dynamically reacting "graviton" system. The supergraviton has a mass slightly greater than 102 atomic mass units but is only present in dense matter. A palladium cathode constitutes dense matter, because its atomic nuclei are of mass commensurate with the supergraviton. Deuterons entering the cathode in the cold fusion cell are associated with a retinue of normal gravitons of much lower mass. The aether sorts this out by converting gravitons into supergravitons and that process sheds some energy as heat. This is another factor to consider, because that heat energy will be concentrated as motion imparted to deuterons in amounts sufficient to trigger fusion.

If the reader wonders what I mean by "supergraviton," then take note that a typical warm superconductor perovskite $La_2CuO_4$ has a molecular mass of 407 atomic mass units, based on copper isotope 65. This means that it is highly tuned to dynamic resonance with the supergraviton, being close to four units of 102 atomic mass units. Such dynamic resonance means that electron collision with the molecules of such a material will not shed much energy as heat. It is as if the impact is transferred to the dynamic mass centre so that the energy is stored conservatively by a spin about that centre, only to be shed by being returned to electrons driven out of the molecules as the system reacts to conserve angular momentum.

The "supergraviton" plays a key role in my interpretation of the warm superconductivity phenomenon. It cooperates with the energy stored by magnetic induction to sustain that electron current flow, even though that means slowing down the thermal motion of those molecules. In other words, there is superconductivity because heat of molecules is converted into electrical power. That means that scientists who discovered warm superconductivity also discovered a regenerative energy process which defies the second law of thermodynamics. It becomes a matter for technological development to harness that discovery to serve a "free energy" purpose in generating electrical power from ambient heat, before the aether gets to work and packages that energy into protons and, of course, accompanying electrons!

**Onwards to that Source of 'Infinite Energy'**

The "supergraviton" is a catalyst that can do the work of the Maxwell demon, but before you learn about "supergravitons," you need to understand something about "gravitons." These are the ghost particles in the heartland of aether energy.

I therefore invite readers to refer to my new book *Aether Science Papers*, which will be the forerunner of my writings on the detailed operation of the specifics of the new energy technology in which I am interested. In that ongoing effort I will be referring to *Aether Science Papers* as the full explanation of the energy source being tapped. Essentially, apart from a 62 page commentary which relates the subject to the new energy field, the book comprises copies of fourteen published papers plus bibliographic references to many of my other published work, including the one in which the supergraviton mass is derived.

See the following summary as published on its back cover. The book is targetted at the theoretical physics community and attacks them on their own ground, where they are weak for not having the good sense to search the aether for those energy sources that have been signalling

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to us and telling us that "free energy" is within our immediate reach.

They will, of course, not fend off such attack, but just wait to see experimental proof of "free energy" machines in operation. That means their surrender once those machines trample over their undefended territory. They do not know how gravitational potential gets its energy, nor do they know how matter is created from the so-called zero-point energy of the vacuum. Once we have that energy in our sights, we can intercept some of it, and the aim of *Aether Science Papers* is to illuminate the aether energy field so that those amongst us who have not already staked a claim can set to work tapping that energy.

### *AETHER SCIENCE PAPERS*
### by Harold Aspden

*The author has, for some 40 years now, sought to interest the world of science in his discoveries concerning the nature of the force of gravitation. His contribution has not been heeded because the research findings have not developed from the conventional theoretical stream. Yet, from his Ph.D. research at Cambridge on anomalous energy activity in ferromagnetism, Dr. Aspden could see so clearly where the mathematical philosophers had erred drastically in replacing the aether by mathematical symbols before they had fully understood how it stores energy. The aether plays a creative role, besides constituting a universal energy bank, giving us the means to deposit and withdraw energy. Left to its own devices it even absorbs the energy we shed as waste and which we write off under the heading 'entropy' but it does something our textbooks say is impossible. It thrives on that energy and regenerates it in a material form by creating the particles we know as protons and electrons. However, scientists have become blind and cannot 'see' such an aether in their vision of things. They look only at how created matter evolves and see no creative source. So they devise computer programs to test their imagination of a universe in a notional Big Bang scenario, with scant regard to the simple problem of how the energy of electromagnetic induction is actually stored in 'empty' space in our laboratories here and now on earth. In so doing they create obstacles in science where none exist, imposing their will on Nature's province and missing key issues which should be obvious to any mechanic. They use equations to represent electrodynamics, say energy has mass, introduce a quantum jitter which makes the position and momentum of that mass uncertain, and then forget to look for whatever it is that accounts for dynamic mass balance and so keeps their jittering wave mechanical universe from tearing itself into pieces. They try to understand gravity as a property of matter and cannot see that it is a property of the aether by which it responds to the presence of matter to keep it in dynamic balance. They complicate gravitation by declaring it to be a distortion of 'space-time' by matter but still cannot reach their objective of field unification. In adopting Einstein's theory mathematicians have confounded our understanding of physics, without realising that there is a better way forward by which to solve the mystery of unification of gravitation and electrodynamics. Although this unification is of clear record in the scientific literature, one needs a guide map to find a way to the relevant clearing in the jungle of periodicals which line university library shelves. This book provides that guidance and goes further in presenting the full text of fourteen of the basic papers. The reader will see from these papers how easy it is to derive the constant of gravity in terms of the electron charge-mass ratio and determine by simple theory the precise value of the proton-electron mass ratio. Given this unifying connection between gravitation and matter creation, one can see a way forward by which to tap some further energy from the same source as that which fed the creation of the universe. We are now on the brink of a technological revolution that will deliver us energy in abundance with no risk of pollution, but we need to understand its source, that real medium, the aether, that so many think of as a mere vacuum.*

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### Selected Excerpts from Dr. Aspden's Energy Science Report No. 8, 1996 "Power from Space: The Correa Invention":

It is debatable at this time whether events will confirm true nuclear "cold fusion" as the source of heat in the well publicized pioneer work of Fleischmann and Pons. It may in fact be another manifestation of the "vacuum spin" phenomenon, by creating in an aqueous electrolyte, or even in the cathode itself, conditions somewhat analogous to those prevailing in the Correa apparatus. Indeed, there seems to be no doubt that the Correa technology itself bridges two of the above "excess energy" categories, electrodynamics and vacuum spin. The Correa method is probably the most advanced of these emerging new energy technologies, being fully reproducible, well researched with its test findings well documented in and protected by granted U.S. patents. It already allows us to tap energy from space itself, or rather the vacuum field activity that fills space, and in contrast with the alternative methods it offers what may prove to be a mobile light-weight power source compared with the heavy apparatus needed where magnets and rotating machinery are involved. Unlike "cold fusion" which generates low grade heat output, the Correa technology generates electricity at power voltage levels.

.....

It will be evident from this that the now-emerging technology for generating power from space energy is destined eventually to upset the physics world and particularly cosmologists. Instead of exercising their criticism to block the breakthrough developments on the new energy front, they need instead to look to their own problems, as now exposed, because they have invested so much time in futile theoretical pursuits that now come under attack.

.....

Even though we will hear much about new technology in the form of anomalous heat generation at water temperatures and new motor technology in which magnets play a dominant role, all pointing to excess energy generation, whichever technology is the first to command enough attention to convert Establishment opinion from disbelief to belief will pave the way for acceptance of the other technologies.

.....

In this race, the Correa technology has a distinct advantage in that it is already the subject of three granted patents in the USA, in that the claims of these patents cover, quite broadly, the three key aspects of what the Correas have discovered and in that the scientific basis is seated in anomalies long recognized in scientific literature by authoritative institutional researchers.

.....

As with any technological development introducing a new electronic device, it will be necessary to involve experts in the design for mass production, with particular attention to the problem of enhancing electrode lifetime. There will be scope for more invention in improved design structure of the electrode configurations and choice and composition of electrode materials, but there are some new and interesting principles embodied in the patented Correa apparatus and these should survive and have value as the technology comes into commercial use.

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# The Super Tube

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**Abstract**

The vacuum polarization of atomic nuclei offer a means to cohere the zero-point energy (ZPE) when plasma ions undergo abrupt surges. Examples include the ion-acoustic resonance and the abnormal glow discharge. A "super tube" which combines the use of the hollow cathode discharge, radioactive cathodes, and inert gas mixtures should create an excessive energy output when tuned to cycle in the abnormal glow discharge regime. Output energy in the form of large voltage spikes are efficiently absorbed by a Pulse Current Multiplier circuit which might offer a solid state means of tapping the zero-point energy.

**Introduction**

There is an interesting dichotomy in theoretical physics today. The equations of quantum electrodynamics utilize an all-pervading energy inherent to the fabric of space called the zero-point energy (ZPE). The energy takes the form of random fluctuations of high density electric fields which can give rise to short lived pairs of elementary particles that are described as virtual. There is also a school of thought represented by a wide range of published papers called random electrodynamics (Boyer, 1975) that describe a real zero-point energy spectrum which interacts with the elementary particles to manifest quantum behavior. The theories show how the ZPE is the basis of gravity (Puthoff, 1989) and inertia (Haisch, 1994), and how it can be an energy source without violating thermodynamics (Cole, 1993, King, 1989). Yet the majority of physicists believe the energy is not real, but rather just a fiction of their mathematics. Note that the zero-point energy terms are quite necessary to accurately predict phenomena in quantum mechanics. Kaku (1995) describes the situation as the greatest disparity in the history of science: The equations describe an energy density on the order of $10^{100}$ ergs per cubic centimeter, yet most scientists believe there is actually zero.

What could be the reason for this disparity? Perhaps the paradigm shift is just too big. The implications of accepting a real zero-point energy drastically change our concept of reality. For example, at large energy densities, space-time pinches into a blackhole. Wheeler's (1962) theory of geometrodynamics describes this phenomena where space pinches into wormholes on the scale of the Planck length ($10^{-33}$ cm) that channel the zero-point energy flux through a physical fourth dimension, which can potentially connect to other, parallel, three dimensional universes (Wolf, 1990). Not only does such a description support Everett's (1957) many worlds interpretation of quantum mechanics, but it also might provide a physical foundation for hyperspatial theories of leading physicists such as Hawkings and Coleman (see Kaku, 1995). Wheeler describes it this way: as this flux passes through our universe it manifests a plethora of mini white-holes (flux entering) and mini blackholes (flux leaving) in a chaotic state of turbulence called the "quantum foam." A temporary vorticity in this flow would manifest as a virtual elementary particle. A stable vorticity on the scale of the Planck length might be the physical basis of the strings supporting superstring theories (Peat, 1988). A real zero-point energy implies the existence of physically real higher dimensions of space.

If higher dimensions exist, then why can't we see them? Ralphs (1994) answers the question quite nicely from the standpoint of perception psychology: the human brain is simply not wired to perceive beyond three physical dimensions. Our concept of space and time is simply a notion filtered and limited by human perception. Perhaps the ancient Hindu and Buddhist philosophies are correct: our concept of the everyday world is really "maya" or illusion. Could the Eastern philosophies actually be right and the Western view of "bottom line" reality be wrong? These implications are probably a little too much for a pragmatic Western scientist to swallow.

A physicist who accepts the existence of the zero-point energy might argue that for all practical purposes the energy available for use is effectively zero, because its action is random and chaotic. Does not the second law of thermodynamics imply random things must forever remain random? This is generally true for closed systems in thermodynamic equilibrium, but the Nobel Prize-winning work of Prigogine (1977) describes other systems that may evolve from chaos to order if the system fulfills the appropriate conditions: 1) It is nonlinear; 2) it is far from equilibrium; and 3) it has an energy flux through it. The behavior of the zero-point energy, especially in its interaction with plasmas, fulfills these conditions and opens the possibility for tapping it as an energy source (King, 1989).

Perhaps the most relevant objection by the scientific community to the notion of tapping energy from space is, "Where is the experiment?" Any hypothesis, especially one that violates the current paradigm, requires an experiment that can be readily repeated by the scientific community to validate it. This paper will review some current plasma research which manifests excessive energy anomalies, and will combine the results with the ideas of a number of inventors to propose the "super tube," a plasma tube that optimally coheres the zero-point energy. Also described will be a circuit that efficiently absorbs high voltage spikes, which might provide the foundation for a solid state method of tapping the zero-point energy. It is an experiment which can detect and cohere the ZPE for a net energy output while self running that will best convince a skeptical scientific community.

**Ions and Vacuum Polarization**

Why can't ordinary electric circuits and antennas detect the ZPE? Quantum electrodynamics answers the question by describing the interaction (i.e. vacuum polarization) of the elementary particles with the ZPE. There is a gradual increase in vacuum polarization intensity approaching closer to the particle. Senitzky (1973) concludes that the vacuum fluctuations

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and the elementary particle are actually inseparably intertwined, i.e. there are no hard boundaries where the particle ends and the vacuum polarization begins. In Wheeler's view the hyperspatial ZPE flux maintains the particle's existence much as a flowing stream maintains an eddy. Also, the different elementary particles have a different vacuum polarization characteristic depending on their situation (Scheck, 1983, Reinhardt, 1980). Electrons, especially bound or in the conduction band, are described as a "smeared cloud" in which the zero-point fluctuations are effectively in thermodynamic equilibrium. In this view, the bound electron would literally be a cloud of net negatively polarized vacuum fluctuations and not a point particle. Puthoff (1987) shows how the zero-point fluctuations and the bound electron reach an equilibrium to produce the stable ground state for hydrogen. The smeared cloud of conduction band electrons offers no concentrated vacuum polarization— or far from equilibrium interaction—that could induce a self-organization in the zeropoint fluctuations. Thus, typical electric circuits and antennas are not able to cohere the ZPE into an energy source.

On the other hand, atomic nuclei exhibit a concentrated vacuum polarization characteristic with the polarization lines converging steeply and stably toward the nuclei center. This offers opportunities for the nuclei to create an augmenting vacuum energy interaction whenever they undergo abrupt motion. Exotic coherent vacuum states are observed in accelerator experiments involving colliding heavy ions (Celenza, 1986, et al.). In the hyperspatial flux model, a surge in nuclei motion bend the ZPE flux, aligning more of it into our three-space. During the surge a greater vacuum polarization would occur, manifesting as an excessive transient in potential or voltage. High frequency voltage spikes (Kalinin et al., 1970), runaway electrons (Kiwamoto, 1979) and anomalous heating (Sethian et al., 1978) are observed in plasmas during ion-acoustic resonance where the plasma nuclei are oscillating. Few researchers have been looking for excessive energy anomalies in academic plasma research. However, a notable exception is Chernetskii from the University of Moscow, who claimed to produce an over unity energy gain from the ZPE in his plasma discharge experiments (Samokin, 1990, Michrowski, 1993). Also Dufour (1993) has measured anomalous heat in his simple sparking experiments. There is also coherent ion motion occurring in sonoluminescence (Barber, 1991), where ultrasonic excitation of water produces an anomalous bluish glow. Nobel laureate Schwinger (1993) suggests the

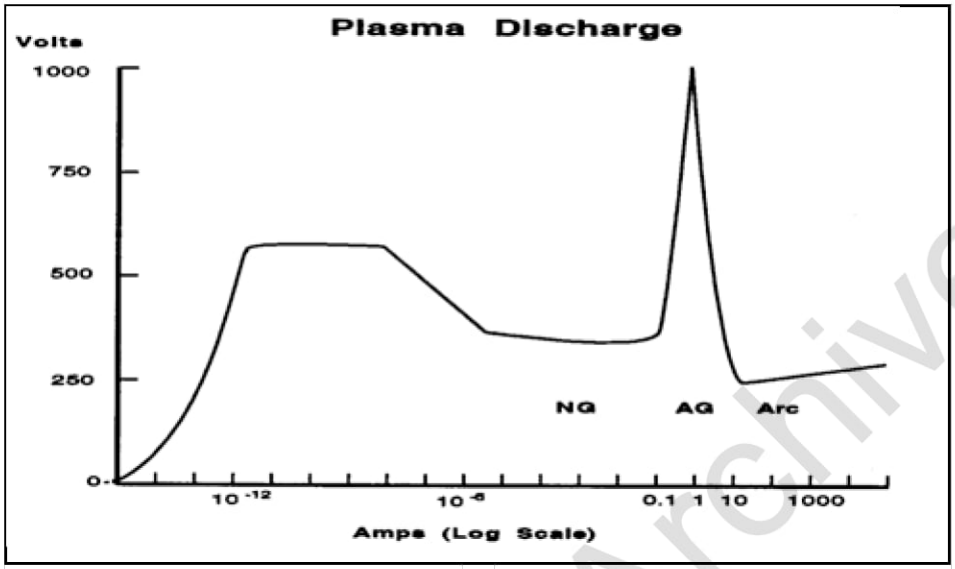


**FIGURE 1.** **Voltage-current characteristic for an electric discharge from gas to plasma showing the regimes of normal glow (NG), abnormal glow (AG), and vacuum arc (Arc). Note the steep negative resistance from the peak of the abnormal glow to the beginning of the vacuum arc.**

source of the anomalous energy is the ZPE. Also there is excess heat and coherent proton motion in the light water, "cold fusion" experiments, where a nickel (or palladium) hydride has (to get the best results) a pure crystalline structure that is fully loaded and subject to pulsed, electrical stimulation (Patterson, 1996, Piantelli, 1995). There is ample experimental evidence suggesting that abrupt, synchronous motion of nuclei in plasmas can induce a zero-point energy coherence.

The principle of using coherent plasma ion motion was the basis of the radiant energy invention of T. Henry Moray (1978, also Resines, 1989, Sego, 1981, King, 1989). Moray stressed the importance of maintaining ion oscillations in his plasma tubes, which used radioactive cathodes as an ionization source. In the 1920's Moray created a two-tube machine that was able to free run and light a single bulb. By the late 1930's he created multiple stages using 30 tubes that output 50 kilowatts of electricity. Each stage oscillated at a frequency higher than the subsequent stage, and the output of each was rectified onto capacitors to be the subsequent stage's input. Moray's radiant energy invention was well witnessed and perhaps the best documented "free energy" machine in history. Many researchers have investigated plasma tubes, occasionally observing some energetic transients, but found it difficult to maintain steady state ion oscillations. One problem is that the frequency of the ion-acoustic resonance (a function of the ion density) increases during the energetic event, which causes more ionization –a highly nonlinear situation. Also, the standard collisional electron modes of the plasma tend to exhibit heating losses, and they remove energy from the electrical modes. Attempting to maintain ion oscillations via holding a steady-state ion-acoustic resonance has proven to be quite difficult in practice. Perhaps there is a better way to induce abrupt, synchronous ion motion.

**Abnormal Glow Discharge**

The Correas (1995) have recently discovered a method to induce stable plasma ion pulsing in their tubes. Moreover, they have demonstrated an over unity electrical energy gain in their experiments. The method relies on carefully tuning the tubes to operate in the abnormal glow discharge regime. The abnormal glow discharge is a glowing, cold plasma located just above the cathode that occurs just before a vacuum arc discharge (spark) whenever the tube is charged slowly. It is characterized by a voltage buildup (Figure 1) where the glow plasma polarizes, yielding a large effective capacitance for the tube. When the voltage reaches a certain threshold, the plasma suddenly snaps from this highly polarized state causing abrupt ion motion and a negative resistance voltage-current characteristic. The abrupt ion surge coheres the zero-point energy. In normal tube operation the tube continues to draw current and proceeds into the high loss, vacuum arc regime. The Correas' patents demonstrate how to limit the current using an appropriate capacitance in parallel to the tube to quench the arc discharge and allow recovery back to the voltage build-up phase. By appropriately adjusting the capacitor recharging circuit, the Correas can tune the abnormal glow discharge cycle to a frequency of choice (anywhere from 10 Hz to 10 KHz), and the tube outputs an over-unity energy gain. It appears that the Correas have discovered

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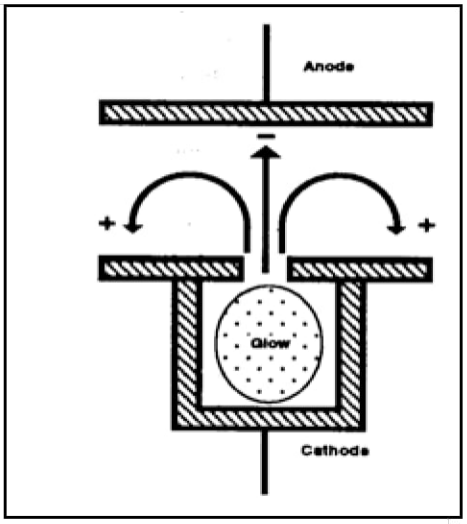


**Figure 2.** **Hollow cathode discharge projects plasma through the aperture. The anode repulses the ions to start a vortex ring circulation.**

the principle with which T. H. Moray tuned his ion oscillator tubes.

The Correas' method can be further enhanced by the use of a hollow cathode which produces a more powerful version of the abnormal glow discharge called the hollow cathode discharge, or pseudospark (Gundersen, 1989). In the mid 1960's scientists in the USSR discovered that a plate cathode with a small hole backed by an attached metallic cylinder could yield a tremendously powerful arc discharge whenever the back cylinder contained a pre-excited, glowing, cold plasma. Applications of this effect focused on the abrupt switching of large currents where the switching could be triggered by a small external excitation (e.g. a light pulse in the back-lighted thyratron). The descriptions of the hollow cathode discharge note anomalies, and its behavior is similar to the abnormal glow discharge. Moreover, during the transient toward vacuum arc discharge, a portion of the hollow cathode plasma surges through the hole (Figure 2) producing a vortex ring circulation (akin to forcing smoke through a small aperture to create smoke rings). The transient appears to manifest the inception of a ball lightning plasmoid (Lewis, 1995) which could further amplify the zero-point energy interaction. A hollow cathode discharge tube tuned to cycle in the abnormal glow discharge regime forms the basis of the super tube.

Depending on the gas pressure within the tube, considerable voltage can be required to induce the glow discharge. Pre-ionizing the hollow cathode plasma greatly reduces the firing voltage. It is well known that coating a radioactive material on a cathode causes pre-ionization and avoids the need to heat the cathode (e.g. McElrath, 1936). Many inventors of free-running energy machines used this principle, e.g. Moray (1978), Papp (1984), Brown (1989). Coating the interior of the hollow cathode with radioactive material pre-ionizes the cathode plasma, augments the negative resistance, and lowers the voltage needed to operate in the abnormal glow discharge regime.

The gas mixture and pressure are likewise important and could significantly increase the energy gain of the super tube. Papp (1984) discovered tremendous energy gains by creating plasmas in a mixture of the inert gases under high pressure. Cooke (1983) has suggested that the noble gases are specially energetic because their nuclei are "interdimensional node points" that tend to channel a hyperspatial energy flux into our three space. Cooke's ideas might gain support from a peculiar anomaly associated with sonoluminescence: Mixing inert gases with the water increases the light output 30-fold (Crum, 1995). In a normal, unenergized state there is negligible interaction between inert gas molecules. However, in the plasma state the ions tend to form into clusters. If mercury vapor is also added to the mixture, then plasmoid clusters packing anomalous energy similar to Shoulder's EV's (1991) might occur. Papp produced an explosive event from his noble gas mixture under high pressure sufficient to drive an engine. Such mixtures could dramatically augment the output of the super tube.

A free-running, two-stage device similar to T. H. Moray's first radiant energy invention can be constructed with two super tubes operating in the abnormal glow discharge regime. The output of each is rectified onto capacitors which gradually charge to become the mutual input current source for the tubes. Once the principles for the two-stage device are understood, a multi-stage machine can be designed.

**Solid State Methods**

The super tube is designed to maximize the ZPE coherence per pulse. But what if we work on a smaller scale using a large number of weak pulses that still produce excessive energy? Then the opportunity arises for solid state ZPE coherers.

A number of investigators have suggested that any abrupt electrical discharge produces anomalously excessive power. Pappas (1991) hypothesized all sparks produce excessive energy. Shoulders (1991) demonstrated that excessive energy can be created in any electrical discharge that produces EV's. What if every spark naturally produces submicron plasmoids (even smaller than Shoulder's EV's)? Finally, there is abrupt ion motion on the inception of any spark, fulfilling Moray' s hypothesis. There is a strong likelihood of some ZPE coupling in any abrupt electrical discharge.

In fact some investigators have proposed that an abrupt voltage pulse with only (vacuum) displacement current and minimal charge motion is sufficient to produce anomalously excessive energy. Bearden (1993) proposed this is his "final secret," and Hyde (1990) used this principle in designing his invention (a mechanical electrostatic field chopper) that reportedly output 20 KW while self-running. Hyde stressed there should be no corona present whatsoever. The Swiss ML Converter could likewise be simply explained, if indeed there were excessive energy in all electrostatic pulses.

Electrostatic pulses or abrupt voltage spikes are notoriously difficult to tap efficiently as an energy source. Many inventors have directed high voltage pulses to recharge batteries with claims of over unity. Unfortunately such pulsing often damages the battery, and of course, an energy machine that cannot self-run, but instead relies on batteries, is unconvincing to skeptics. Clearly, what is needed is a method to convert voltage spikes to a useful form of power, preferably DC.

Hyde (1990) had to solve this problem in order to make his machine free-running. His solution (described in figure 6 of his patent, also King, 1993) took advantage of the fact that even though the individual electrostatic pulses were of high voltage, the current (and thus power) of each was very low. This allowed Hyde to make a voltage divider / current multiplier circuit utilizing a large number of inexpensive capacitors and diodes that could be run in excess of their voltage specification without damage. High voltage electrostatic pulses were converted to amplified current pulses at a lower voltage, which were then rectified to DC by standard means. Hyde empirically solved a difficult engineering problem, and the solution allowed him to build a self-running energy machine.

An easy to build, efficient current multiplier would facilitate widespread experiments to investigate claims of excessive energy in electrostatic pulses or sparks, as well as form the basis for a solid state zero-point energy machine. The following Pulse Current Multiplier (PCM) was inspired by Hyde's invention. The PCM is based on the standard voltage division technique of charging a bank of capacitors in series, then discharging them in parallel. Figure 3 illustrates four stages of the PCM. In practice it is desirable to have ten or more stages. The high voltage pulse is input across the A terminals at the polarity shown. The output current pulse occurs across the B terminals. The inductors' purpose is to block the sharp input voltage pulse (via high impedance) and channel it down the (low impedance) series path which should be physically short. The sharper the voltage spike, the better the performance. The inductances should be the minimum value necessary to block the input, for they must allow the output cur-

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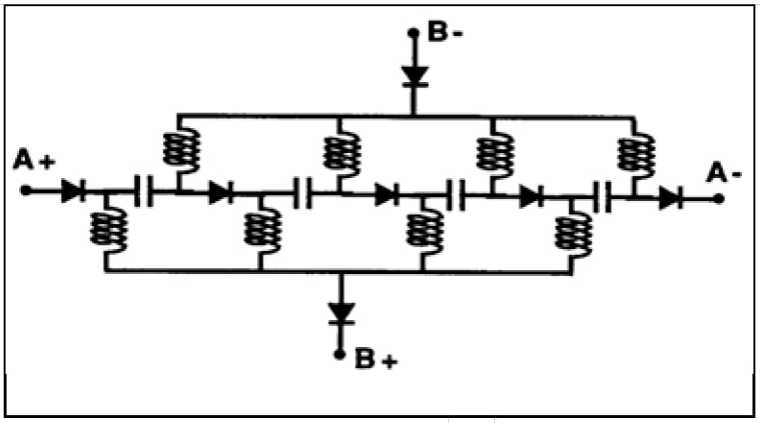


**Figure 3.** **Pulse Current Multiplier (PCM) converts unipolar voltage spikes (input on the terminals) to current pulses (output on the B terminals). Four stages are shown, but in practice ten or more should be used.**

rent (as a slow rise time pulse) to pass with minimal attenuation. Hyde did not show any blocking inductances in his patent. Since he developed his circuit empirically, perhaps long or coiled output wires provided a sufficient blocking inductance to achieve the same behavior.

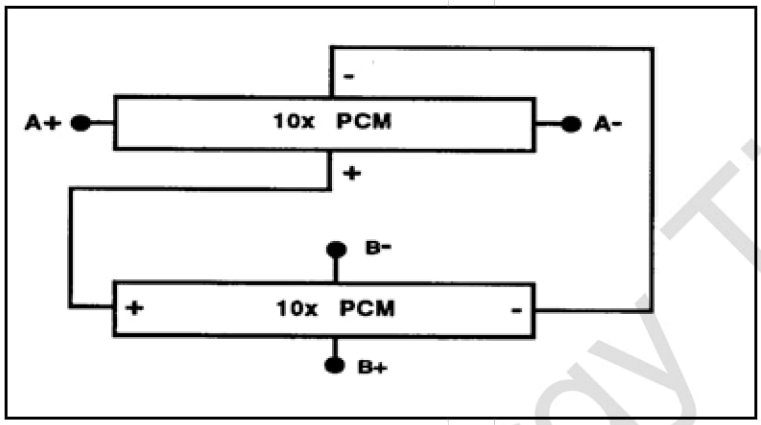


**Figure 4.** **Combining two 10-stage Pulse Current Multipliers in series to create a 100x PCM. Input is on the A terminals; output is on the B terminals.**

Ferrite beads might also suffice. Since the PCM uses inexpensive components, it offers an economical investigation of a possible ZPE coherence associated with high voltage pulses and discharges.

A ten-stage PCM amplifies the current by a factor of ten. Two such PCM's can be combined in series to create a multiplication factor of 100 (Figure 4). The output from the first PCM is impressed across the input of the second. Since the pulses entering the second PCM will not be as sharp, larger blocking inductances will be required in it. The principle can be extended to a third PCM in series to give a multiplication factor of 1,000. Thus a sharp 40 KV spike could be stepped down to a less steep 4 KV pulse and then to a wider 400 volt pulse. The second and third PCM's will require more robust circuit components since appreciable current is being accumulated. Once the pulses become sufficiently wide, then standard solid state switching technology can be used instead of the blocking inductances to create a PCM via standard electrical engineering, voltage division techniques. Such a PCM could be employed last in the series. An appropriate configuration of PCM's can thus become an efficient voltage spike converter.

The PCM can only absorb unipolar input pulses. If both positive and negative pulses are supplied, two PCM's can be combined to create a bipolar pulse current multiplier, Figure 5. Here the input pulse naturally channels through the appropriate PCM, gated by the diodes similar to a full wave rectifier. The bipolar PCM can convert the energy of both positive and negative voltage spikes. A small, low-powered Tesla coil can be used to create high voltage pulses of dual polarity which can stimulate the bipolar PCM via electrostatic (capacitive) coupling (Figure 6) to investigate Bearden's hypothesis, or use a spark gap or tube (Figure 7) to investigate Pappas' hypothesis. Also, in place of the tube could be any material (e.g. a proton conductor, Mizuno, 1993) that manifests abrupt ion motion in response to the voltage pulses. The setup facilitates empirical testing of many materials to discover which produces the best energy gain. It is interesting to note that the slow switching diodes of the PCM fulfill Bearden's (1993) requirement of a "degenerate conductor," where conduction current is delayed so as not to drain the supplying pulsed voltage source. A Whimshurst machine could likewise provide sharp unipolar electrostatic discharges to the PCM. If excess output is observed, then the Swiss ML Converter could be explained. If there is indeed excess energy embedded in high voltage spikes or sparks, the PCM could convert this energy to a form that could be efficiently rectified to DC. The DC could drive the input pulsing source and allow the creation of an economical, solid state, self running circuit that taps the zero-point energy.

**Summary**

The most important step in convincing the scientific community that energy can be extracted from the ZPE is creating an experiment in the form of a self-running energy machine that can be freely replicated. There are both theoretical descriptions of nuclei vacuum polarization as well as energetic anomalies observed in plasma ion-acoustic resonances to suggest that the abrupt motion of plasma ions can yield a ZPE coherence. The Correas' patents have shown how to tune plasma tubes to oscillate in the abnormal glow discharge regime to produce controlled ion surges, while avoiding the losses associated with vacuum arcs. They have been able to demonstrate an over unity energy gain. The Correas' discovery can be further enhanced by the use of hollow cathode discharges to produce an even greater ion surge. The use of radioactive cathodes, as T.H. Moray discovered, pre-ionizes the glow plasma and greatly reduces the firing voltage. The use of inert gas mixtures, as Papp discovered, may further augment the energy output as well. Combining all the ideas leads to the super tube, a plasma tube that optimally coheres the zero-point energy.

Since ion surges often manifest excess energy as very sharp voltage spikes, a pulse current multiplier circuit has been suggested as a means to efficiently step down large voltage spikes and convert the power to useful current pulses. PCM's can be combined in series or parallel to produce greater current multiplication or bipolar pulse rectification. The PCM can also be used in a general test set up to receive voltage spikes from sparks or materials that contain embedded free-moving ions. The ions abruptly surge in response to a stimulating voltage pulse and through ZPE coupling produce an excess voltage transient. The PCM can efficiency convert the voltage transient, allowing it to be rectified to DC. If sufficient output power is generated, it can be fed back to drive the input. This could lead to an easily built, solid state, self-running device for the scientific community to replicate. It would demonstrate that it is possible to tap the zero-point energy as an energy source.

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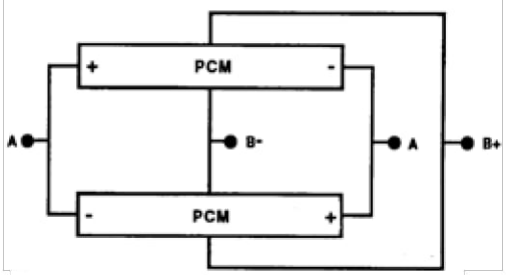


**Figure 5. Bipolar Pulse Current Multiplier can convert bipolar voltage spikes (input on the A terminals) to unipolar current pulses (output on the B terminals). Two PCM's are connected in the polarity shown, giving full wave rectification of voltage spikes.**

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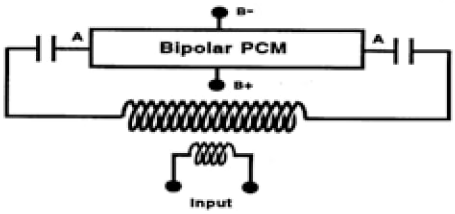


**Figure 6. Tesla coil drives a bipolar PCM through air-gap capacitors to test if high voltage electrostatic pulses can generate an energy anomaly. In this control test there must be no corona.**

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Brown created a 5 watt nuclear battery using a weak (one Curie) radioactive source, Krypton 85. Since the radioactive source could only provide at best 5 milliwatts, Brown created an anomalous self running energy device. Brown used an LC oscillator, where the radioactive material ionized a corona around the coil. If the circuit is tuned to the ion-acoustic resonance of the corona, then the ion-oscillations could couple a ZPE coherence directly to the circuit.

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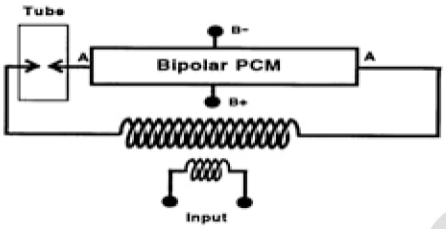


**Figure 7. Tesla coil drives a spark gap or plasma tube through a bipolar PCM to convert voltage spikes to useful power. Any material that manifests abrupt ion motion in response to high voltage pulses may be substituted for the tube to create a solid state method of tapping zero-point energy.**

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# Scientific Revolutions

**Dr. Ramon Prasad England**

Thomas Samuel Kuhn died on 17th June 1996, one month short of his 74th birthday. His famous book *The Structure of Scientific Revolutions*, first published by University of Chicago press in 1962, has sold more than one million copies and has effectively become the standard text on History and Philosophy of Science. The complex thesis contained therein contains much that is of great interest to Cold Fusion theorists and experimentalists, trying to understand their relationship with the scientific establishment.

He discovered, while preparing a series of lectures designed to demonstrate the cumulative theory of the development of scientific knowledge, that the official doctrine was the reverse of the truth. That science proceeded via a series of "revolutions," designated by him *abnormal science*, interspersed with periods of quiescence or "mopping up" operations, which he called *normal science*. He validated his thesis with a series of case histories showing that a new theory, not necessarily based on what had gone before, started as a small wave which gradually became tidal. Scientists changed sides at the height of the revolution, leaving behind a small group who refused to change after the revolution had passed. Of course this did not happen with every new idea, but only with ideas which had this destiny. Kuhn did not give a recipe for deciding which class new ideas were in, but he did give remarkable demonstrations that revolutions that have happened in past fall into this pattern.

The debate between adherents of the differing schools was frequently at cross-purposes. An example from chemistry illuminates the point (ref. (1)):-

*"At the end of the eighteenth century it was widely known that some compounds ordinarily contained fixed proportions by weight of their constituents. For some categories of reactions the German chemist Richter had even noted further regularities embraced by the law of chemical equivalents. But no chemist made use of these regularities except in recipes, and no one until almost the end of the century thought of generalising them. Given the obvious counterinstances, like glass or salt in water, no generalisation was possible without abandonment of affinity theory and a reconceptualization of the chemists domain. That consequence became explicit at the very end of the century in a famous debate between the French Chemists Proust and Berthollet. The first claimed that all chemical reactions occurred in fixed proportion, the latter that they did not. Each collected impressive evidence for his view. Nevertheless, the two men necessarily talked through each other, and their debate was entirely inconclusive. Where Berthollet saw a compound that could vary in proportion, Proust saw only a physical mixture. To that issue neither experiment nor a change of definitional convention could be relevant. The two men were as fundamentally at cross-purposes as Galileo and Aristotle had been.*

*"This was the situation during the years when John Dalton undertook the investigations that led finally to his famous chemical atomic theory. But until the very last stages of those investigations, Dalton was neither a chemist nor interested in chemistry. Instead, he was a meteorologist investigating the, for him, physical problems of the absorption of gases by water and of water by the atmosphere. Partly because his training was in a different speciality and partly because of his own work in that speciality, he approached these problems with a paradigm different from that of contemporary chemists. In particular, he viewed the mixture of gases, or the absorption of a gas in water as a physical process, one in which forces of affinity played no part. To him therefore, the observed homogeneity of solutions was a problem, but one he thought he could solve if he could determine the relative sizes and weights of the various atomic particles in his experimental mixtures. It was to determine the sizes and weights that Dalton finally turned to chemistry, supposing from the start that, in the restricted range of reactions that he took to be chemical, atoms could only combine one-to-one or in some other simple whole-number ratio. That natural assumption did enable him to determine the sizes and weights of elementary particles, but it also made the law of constant proportion a tautology. For Dalton, any reaction in which the ingredients did not enter in fixed proportion was ipso facto not a purely chemical process. A law that experiment could not have established before Dalton's work, became, once the work was accepted, a constitutive principle that no single set of chemical measurements could have upset. As a result of what is perhaps our fullest example of a scientific revolution, the same chemical manipulations assumed a relationship to chemical generalisation very different from the one they had had before.*

*"Needless to say. Dalton's conclusions were widely attacked when first announced. Berthollet, in particular, was never convinced. Considering the nature of the issue, he need not have been. But to most chemists Dalton's new paradigm proved convincing where Proust's had not been, for it had implications far wider and more important than a new criterion for distinguishing a mixture from a compound....What chemists took from Dalton*

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*was not new experimental laws but a new way of practising chemistry, and this proved so rapidly fruitful that only a few of the older chemists in France and Britain were able to resist it. As a result, chemists came to live in a world where reactions behaved quite differently from the way they had before."*

What lessons can we learn from this example in the debate over Cold Fusion? There are many, but projections from the past into the future are notoriously difficult and controversial. Further, cold fusion at this stage is a collection of experimental results not a theory. There is at this time no Dalton for cold fusion theory, and probably not a Proust nor a Berthollet, but we can make out some parallels between their debate and ours.

Because of way in which the cold fusion era started with the Fleischmann-Pons announcement, together with the three flawed attempts at replication, the scientific community is polarised between two opposing paradigms, one that cold fusion exists, the other that it does not. The first lesson we can draw from Kuhn's example is not to be too concerned about this. It is absolutely to be expected in a development of this kind. Patient accumulation of high-quality experimental results will yield results. However impervious the scientific establishment may appear, this is just a mask of external show covering an internal debate. If cold fusion is an idea with the appropriate "destiny," as I believe it is, then it is only a matter of time before the revolution begins to gather apace.

It is interesting to note that both Proust and Berthellot would have been "right" if they had used the word *sometimes* instead of *always*. The existence of both mixtures and compounds is hardly a controversial topic in chemistry today. Dalton, because he came to the subject from a different specialism, had a "wrong" idea in his mind from the point of view of the chemistry of the time. Here lies a very large lesson for today's scientists. The nature of the debate frequently is in the form that this experimental result contradicts that known result, and is therefore invalid. In a domain in which much remains to be found, misinterpretations are bound to be legion. An example from another field is Marconi's successful attempt to transmit radio waves across the Atlantic in 1901. It should have failed. His transmission was successful because the ionosphere, which he knew nothing about, reflected his signal back to the earth instead of allowing it to proceed out into space. He was right for the wrong reason. The lesson: a result may be invalid because it depends upon a chain of positives, and somewhere in the middle there is a negative entirely unconnected with the matter at hand To discover the chain requires patient investigation.

A multiplicity of points of view seems something to be regretted. The desire for uniformity and conformity seems to be very great. We all believe in x, and anyone who does not believe in x is not a scientist. This point of view stifles progress and distorts free scientific investigation. It is in the nature of a paradigm shift that what was previously held to be true is no longer held to be true. Cold fusion seems to suggest that it is possible to activate nuclear processes by electrochemical means, something that has heretofore been considered impossible. But it may be possible. The correct response is not to enter into denial, but patient investigation. Are there nuclear products? If there are, and reports have been published in *Infinite Energy* which show that there are, then the conclusion is unmistakable.

Cold fusion will have to develop a satisfactory theoretical basis if it is to become a branch of establishment science, as I believe it will. Theoreticians must be prepared to speculate and make leaps in the dark. There is absolutely no reason why a newly discovered phenomenon should have a theoretical explanation lurking in the undergrowth of established physical theory, apart from the conceit of established theoreticians. They would have you believe that everything is known and comprehended. A glance at Blatt and Weisskopf[2] will surely show that a very great deal more is not within the domain of understanding. To take a simple example: why are the proton and neutron bound together by nuclear forces, whereas two neutrons are not? Of course we can set up an isotopic spin formalism and say that this channel has an attractive binding force, and that one does not, but that is simply to wrap the fact up in scientific jargon. The strong nuclear force has a coupling constant greater than unity, which means that each more complicated process is more probable than the one before. Then processes of unimaginable complexity must be happening, yet the end result is the beautiful symmetries and regularities of the nuclear periodic table. How then do these arise? The conclusion: more is not known than is known about how nuclear forces operate.

If the cold fusion phenomena turn out to be dependent on nuclear processes, then it does not only hold the promise of utilizable energy, it also provides a new handle on the understanding of the nucleus itself. What is preventing nuclear scientists from jumping at the chance and into the subject? I think it was J.K.Galbraith who said that the vested interests of the mind were more powerful than any commercial ones. The theoreticians have a difficult and demanding task in front of them. But the history of science shows, strangely, that humanity is rarely confronted by impossible problems. They are difficult but they will yield to patient and determined investigation. If the perspectives of Thomas Kuhn are anything to go by, we must expect rival schools of explanation to come into existence. This is not something to be regretted any more than the multiplicity of different experimental techniques and procedures is to be regretted. The tension of this dialectic will ultimately yield truth and understanding, just as the competition to build the most efficient device will actually generate one.

The lack of funding is a serious impediment to theoretical and experimental development, but only a temporary one. The very large amount of money poured into hot nuclear fusion, although now reducing somewhat, shows that society is prepared to pay for the development of new sources of energy. In the long term the money will probably be there. In the short term, cold fusion scientists will have to do what innovators have always done: find ways of financing their own research. *Infinite Energy* plays an important role here by publishing articles on theoretical and experimental investigations which are at the initial stage of development. This is a difficult time. But cold fusion scientists might ponder the consequences of success on themselves. Thomas Kuhn shows the outsider theory progressing all the way through the scientific hierarchy to become a bastion of the establishment. Will cold fusion scientists of today expecting generosity from their more fortunate colleagues, be generous to the outsider of that time?

Official science has been very slow to accept the theories of Thomas Kuhn, as opposed to the philosophers and historians of science. The reason is that scientists are not depicted in the flattering clothes which they imagine themselves to be always wearing. Scientists have the same weaknesses and frailties as all other human beings. But they are dressed up in text-books and in the media as superheroes with magnificent achievements. This they most certainly are not. Thomas Kuhn has brought us closer to science as actually done, and, if we have the strength of character to take on board his insights, our own scientific endeavour will contain less pomp and more truth.

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**Biographical Note**: ***Ramon Prasad has worked as a mathematics lecturer for most of his life, and has published a number of books on Unified Field Theory.***



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# Controlled Transmutation of Elements Under Surprisingly Mild Conditions?

**by Paul E. Rowe**
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**July 7, 1996**

### Introduction

Bockris and Minevski[1] of Texas A&M University recently reported experimental results which strongly suggest that palladium atoms near the surface of hydrogen atom-saturated catalysts are transformed into atoms of other elements under certain mild electrical conditions.

Minzuno, T., Ohmori, T., and Enyo, M.,[2] reported similar results with palladium catalysts saturated with deuterium atoms. The isotope make up of some of the elements produced were quite different than that which occurs in nature.

It is extremely difficult (perhaps, impossible) to explain these experimental results, unless one accepts that transmutation of elements has occurred during these experiments.

This paper will attempt to show that experimental results reported prior to 1930 lead to a similar conclusion.

### Discussion

Between 1910 and 1930, many experimenters (some extremely well respected) reported the mysterious appearance of hydrogen, helium and neon in electrical discharge tubes. E. C. C. Baly, a Fellow of the Royal Society, summarized the results in *Annual Reports of the Chemical Society* for 1914 (pages 41 to 47) and 1920 (pages 27 to 35). He published results of his own experiments with R. W. Riding in (1925[3] and 1926[4]). They concluded that nitrogen atoms had been converted into helium, neon and possibly other atoms in their experiments.

On February 13, 1914, Professor J. Norman Collie, Fellow of the Royal Society, presented a speech[5] to the Society. He described several experiments performed by himself and others in which hydrogen, helium, and neon gases mysteriously appeared in electrical discharge tubes. The following quote is the last paragraph of his speech.

> "This fact cannot be explained by air leakage, for air contains four or five times as much neon as helium. At present the investigation was only begun; many more experiments would have to be made for the source of the helium and neon was still obscure; but if it could be proved that these gases were produced from many metals and other substances under the influence of cathode discharge, it is obvious that it would be a discovery of the most far-reaching importance."

These experiments were later described in more detail[6].

In 1923, Baly[3] had experiments performed by Dr. R. A. Bailey who tried many variations of reported experiments. He found no neon or helium.

In a short paper[7], Robert Goddard, the pioneer rocket scientist, discussed the apparent production of rare gases in discharge experiments. The final paragraph of the paper follows:

> "It is by no means certain, however, that the action in question consists simply in the liberation of absorbed gases, for Sir J.J. Thomson has discovered evidence of a genuine production of helium and $X_3$ from elements (lead) and chemical compounds (salts of sodium and potassium) which suggests an actual atomic change, if not a genuine disintegration. The whole problem is very complicated, and it is the writer's purpose merely to call attention to the importance of surface conditions in the production of rare gases."

$X_3$ was later found to be $H_3$ (triatomic hydrogen, which has a half life of about 1 minute[8]).

Sir J.J. Thomson was Cavendish Professor of Experimental Physics at Cambridge University. This post was once held by Sir Isaac Newton and is presently held by Stephan Hawking. Thomson was awarded the Nobel Prize in physics for his work and is known as the discoverer of the electron.

In a book originally published in 1913, Thomson described the production of helium and neon during the bombardment of various chemicals with cathode rays. The following quotes are from this book[9]:

> "To test whether this was the source of the helium I bombarded soluble salts such as LiCl, NaCl, KCl, KI, RbCl, $AgNO_3$ which were dissolved in water and also in some cases in alcohol and then evaporated to dryness, the process being in some cases repeated several times. Salts which had been treated in this way yielded helium and in some cases neon; the yield of helium from the salts of the alkali metals and in particular from potassium was exceptionally large, KI giving a larger supply than any other of the substances I examined, with the exception of those like monazite sand which are known to contain large supplies of helium. Some of the salts have yielded apparently undiminished supplies of helium, after being dissolved and evaporated ten or twelve times."
>
> "The aluminum cathode in the tube used to bombard the substances with cathode rays might be suspected as a source of helium. If this were the case, however, the rate of production of helium would not depend upon the nature of the salt bombarded, nor would it make any difference as to whether the cathode rays hit the salt or not. As both these conditions have a great influence on the rate of production of helium we may regard this source as eliminated. In addition to the proceeding considerations some of the cathodes have been in almost continuous use for months without any perceptible diminution in the rate of supply of helium."

If the source of helium and neon was diffusion through the gas walls of the apparatus, the nature of the salt bombarded would have no effect on the rare gas concentration.

> "The view that helium can be got from other elements raises questions of such a fundamental character that few will be prepared to accept it until every other explanation has been shown untenable. It would greatly strengthen the proof if we could detect the parts of the atom which remain when the helium is

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split off."

Perhaps, some of the atoms recently detected[2] are parts of atoms which remain when the helium is split off.

In 1925, Riding and Baly[3] reported results of experiments performed in a discharge tube having a concave cathode which focused onto a hollow aluminum anticathode coated with a thin nitride film. A discharge in low pressure oxygen (below 2 torr) produced measurable helium after 42 hours. The following quotes are from this paper:

"At that time the suggestion was made to us by Prof. Masson that the results obtained by him in conjunction with Collie and Patterson might be due to the disintegration of nitrogen, this element being present in the form of nitride as a surface film on the electrodes."

> "The first experiments were carried out with hydrogen, but negative results were obtained. On replacing the hydrogen by oxygen a positive result was at once obtained, since after 42 hours discharge a small quantity of helium was formed. Emphasis must be laid on the fact that in many previous experiments with the same induction coil and the same design of discharge tube, without a nitride layer no trace of rare gas was ever obtained."
>
> "On repetition of this experiment, the discharge being passed for longer periods (90 to 100 hours), it was found that hydrogen, helium and neon were formed. It is of considerable interest to note that the relative proportions of helium and neon were the same as those obtained by Collie and Patterson."
>
> "We would again emphasise the fact that no trace of either helium or neon is formed in the absence of a nitride film, and this would seem to exclude the presence of an air leak, since it is not possible to believe in a leak which only occurs when the anticathode is coated with nitride. In addition to this, we have many times confirmed the well known fact that the spectrum of the residual gas left after treatment of air with charcoal cooled in liquid air shows only the spectrum of neon. These results would suggest that the rare gases found by Collie and his co-workers were due to the atomic disintegration of nitrogen and not to synthesis from hydrogen. This conclusion has been confirmed by a number of subsequent experiments which may be briefly described."

Other experimenters have shown that helium and neon from the air slowly diffuse through very hot glass walls into vacuum. They suggested that such an effect might explain the above results. Reasons for this view were summarize by Robert W. Lawson of The University, Sheffield[10]. However, this does not explain the appearance of these gases only when the oxygen is present and the anticathode has a nitride coat.

The following quotes are from Baly and Riding's 1926 paper[4]:

> "We have now carried out some further experiments which would seem to confirm our original results. In the first place, both helium and neon have been obtained by passing the discharge between a concave aluminum mirror as cathode and a magnesium anode through a mixture of oxygen and nitrogen under reduced pressure. No trace of the rare gases was formed if the discharge were passed in the opposite direction; and since in this series of experiments the two types of discharge were used alternatively, the same mixture of oxygen and nitrogen was used, and the apparatus was not changed in any way, this would obviate any possible criticism that the rare gases had their origin in an air leak."

It also obviates any possible criticism that the rare gases had diffused through the glass walls of the apparatus.

> "As to the origin of these gases, we believe that they arise from the disintegration of the nitrogen atom. Attention may be directed to the fact that hydrogen is always to be found in the residual gases along with the helium and neon, although the greatest possible care was taken to remove it from the electrodes before each experiment. At the same time it may be pointed out that in spite of all precautions it is impossible to secure the total absence of oxides of carbon."

Baly and Riding's conclusion that nitrogen atoms are transformed into helium and neon atoms (and possibly other atoms), under their experimental conditions, did not conform with the then or present views of theoretical nuclear science. They measured the emission spectra of gaseous products. Bockris and Minervski's[1] results, confirmed by those of Minzuno, T., Ohmori, T., and Enyo, M.,[2] suggest that, under somewhat different conditions, palladium atoms are transformed into platinum, silicon and zinc and possibly other atoms. They did not measure gaseous products.

**Conclusion**

The simplest conclusion from the above results is that transmutation of elements has been caused to take place under surprisingly mild conditions. Theoretical nuclear scientists find that such a conclusion defies some of their time-honored concepts. I, for one, am willing to consider that these concepts are incorrect.


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*For six years he was a Project Chemist at the National Northern Division of the American Potash Company in Hanover, Massachussetts, where he helped develop explosive and propellent mixtures, primarily for military use.*

*For 21 years, he worked at the Emerson & Cuming Division of W.R. Grace Company. He helped develop various new products in the dielectric materials field. These included radar absorbers, lenses and reflectors, and plastic, glass and ceramic dielectrics. He also assisted in developing deep water flotation for off shore oil exploration.*

*In 1980, he retired as Director of Research and Development and became a consultant in these fields. He says, "This gave me time to pursue my belief, based on analysis of gaseous products of explosions in vacuum, that hydrogen gas can be produced in and from vacuum."*


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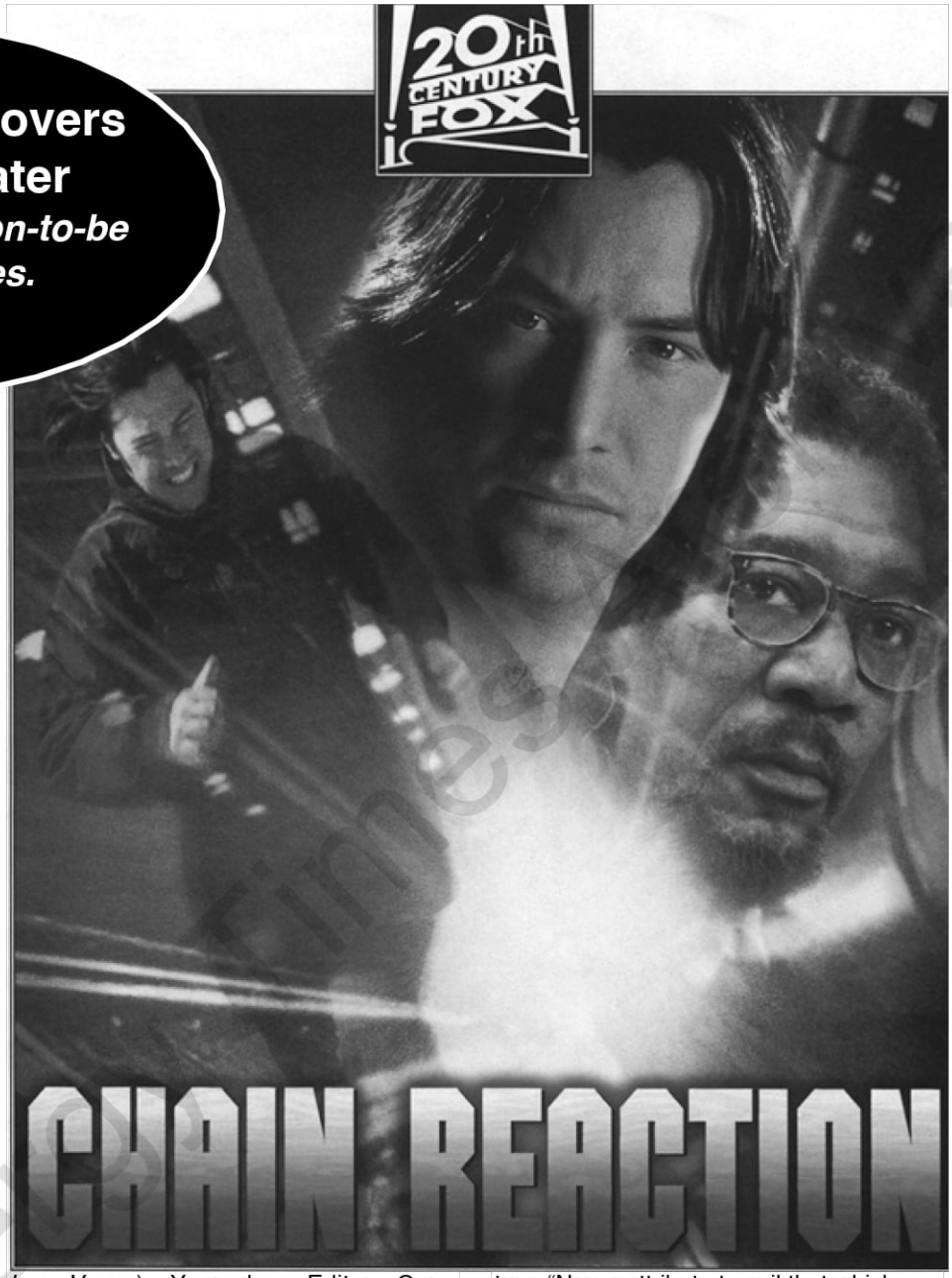
# Hollywood Discovers Energy from Water

## — *in recent and soon-to-be motion pictures.*

by
**Eugene Mallove**

## *A "Chain Reaction" of New Energy Movies*




Just as the cold fusion and new energy revolution are triumphing scientifically and beginning to be commercially developed, there is sweet background music—a bevy of movies devoted to New Energy themes.

The first to reach public attention, playing now in cinemas across the U.S. and shortly in many other countries, is *Chain Reaction*, for which we can thank 21st Century Fox. Their PR office generously provided *IE* with the text and artwork that appear in this article.

*Chain Reaction* is an exciting film for those of us in cold fusion and New Energy. It may be weak scientifically, but by offering the premise of "water as the fuel of the future" it is extraordinary. For us it is a consciousness-builder. Predictably, several major newspaper reviewers in the U.S. panned the movie for having an "implausible" or "absurd" premise!

Two other major motion pictures dealing with energy from water should be seen on the big screen next year. One techno-thriller titled *Breaking Symmetry*, by movie writer, director, and producer, retired MIT Professor Keith Johnson, is already being filmed in Cambridge using some backdrops of MIT scenery. The MIT administration appears to be running very scared about this film, because its message about suppressed technology and fudged data strike very close to home. We thank Professor Johnson for his synopsis of *Breaking Symmetry* later in this article.

Also in production now, a film by Paramount Studios, *The Saint*, which focuses centrally on cold fusion. It is scheduled to make its debut early next year, with mega-star actors Val Kilmer (*Batman*) and Elizabeth Schue (*Leaving Las Vegas*). Your dear Editor, Gene Mallove, was a technical consultant on that film. However, it was clear on first reading the script that *The Saint* writers had assimilated much of the essence of the cold fusion story, properly identifying the "bad guys" (e.g. *Nature* magazine) and even referring to heroes Pons and Fleischmann!

Back to the movie that is playing *now. Chain Reaction's* fictional premise is that energy can be obtained from water— by implication with much less energy going in than coming out. At one point the over-unity is explicitly stated. Furthermore, the movie portrays various dark forces within the government who work against this discovery "because it would be too destabilizing" to world petroleum markets and the status quo. In real life, of course, those dark forces are the U.S. Department of Energy and many in brain-dead academia. Chain Reaction's writers ignored the dictum: "Never attribute to evil that which can more readily be explained by stupidity."

The lead actor, Keanu Reeves, is a machinist who is working on a quiet research project at the University of Chicago—shades of the Manhattan Project at the same locale. By accident, the acoustic frequencies from his lathe lock onto his water-filled sonoluminescence cell—the SL word appears several times in the movie—and stimulates a glowing, sustained reaction. At two points in the movie a giant explosion occurs—near the beginning and at the end. The explosion at the research lab is said to be a hydrogen gas explosion, but it is of vast size. The first one destroys eight city blocks in Chicago. This is a serious technical flaw, but then again, many in the general public don't know beans about the difference between chemical and nuclear energy. Water is shown to be dissociated

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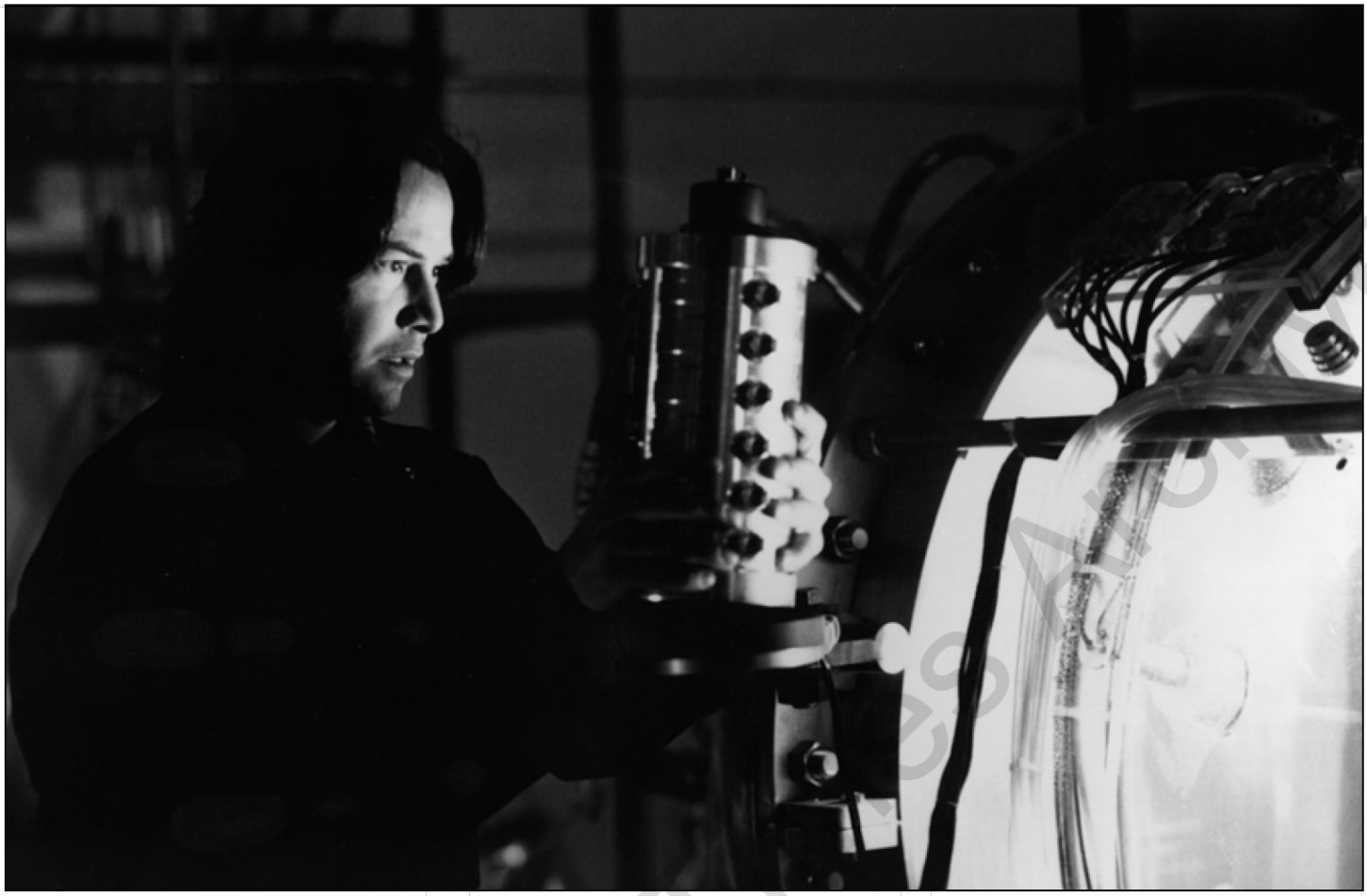

**Keanu Reeves** stars as machinist Eddie Kasalavich, a member of a team of visionary research scientists who have developed a new source of energy in ***"Chain Reaction."*** ***Photo: Michael Weinstein***

sociated and hydrogen gas levels are indicated to be rising before the explosion is triggered. The implication was of a nuclear aspect or something beyond ordinary chemistry.

Good wins out in the end and the "secret frequencies" that allow the liberation of the hydrogen at minimal input power (a lá the *claims* of at least some people on the fringes of this field, e.g. Stanley Meyer) are broadcast on the Internet by the heroes to "thousands of good scientists" all over the world.

*Breaking Symmetry* and *The Saint* will be orders of magnitude more faithful to the real cold fusion story, but the message of *Chain Reaction* may begin to get the public thinking about suppressed energy technology. The connection to cold fusion and free energy will certainly be made by many people. The movie presents the serious idea that if you hit water with something "magical," such as a tuned laser beam, you might get it to do something very powerful — a lá thermonuclear fusion. (Fusion, per se, is never mentioned in the movie.) The phrase "free energy" was used at least once, though.

As the credits rolled, I thought how much we *in the real field* could have accomplished with the money that went into producing *Chain Reaction!* Grrrr-rrr! Perhaps the fine actors and producers of these movies will see to it that a fraction of the popcorn and soda money are contributed to the field?

## Production notes for *Chain Reaction* provided by 21st Century Fox...

*Imagine ... a new source of clean, limitless energy to replace gas and oil.*

*In a University of Chicago research lab, a team of scientists and technicians have achieved an earth-shaking triumph. After years of tireless work, they have tapped a simple, yet almost infinitely powerful way to produce energy from water — cleanly, efficiently, abundantly —for a fuel-starved, pollution-weary world.*

*What impact will this discovery have on us all?*

*Student machinist Eddie Kasalivich and scientist Lily Sinclair are about to get the explosive answer. Suddenly caught in a chain reaction of murder and high-tech espionage, the two colleagues are forced to go on the lam after being framed for the murder of their mentor, visionary scien-tist Dr. Alistair Barkley, and the sabotage of their laboratory. Barkley had been determined to give details of the discovery freely to all nations. Others insisted on discretion and would go to any lengths to keep it from getting out.*

*With a half-dozen federal agencies pursuing them across the country, Eddie and Lily set out to discover who is behind this far-reaching, shadowy and deadly conspiracy in a dizzying chase across new frontiers of science and adventure.*

Twentieth Century Fox Presents A Zanuck Company/ Chicago Pacific Entertainment/Arne L. Schmidt Production, An Andrew Davis Film, Keanu Reeves, Morgan Freeman in CHAIN REACTION, also starring Rachel Weisz, Fred Ward, Kesin Dunn, Brian Cox. The action-thriller is directed by Andrew

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Davis, and is produced by Arne L. Schmidt and Andrew Davis. The screenplay is by J.F. Lawton and Michael Bortman, from a story by Arne L. Schmidt & Rick Seaman and Josh Friedman. The executive producers are Richard D. Zanuck and Erwin Stoff. The director of photography is Frank Tidy, B.S.C. The production designer is Maher Ahmad, and the film editors are Donald Brochu, Dov Hoenig, A.C.E. and Arthur Schmidt. Music is by Jerry Goldsmith.

Machinist Eddie Kasalivich should have been continuing the joyous celebration of the team's breakthrough discovery, and what looks like a brilliant career in science.

Although lacking the formal education of his colleagues, Eddie's made a key contribution to an incredible device which could solve the world's energy problems.

But global politics and mysterious, all-powerful entities didn't figure into Eddie's equations. He's helped unleash much more than cheap energy; he's brought about an unstoppable series of events whose aftershocks will turn his world upside-down.

A complex figure who's an exciting contradiction of blue collar grit and intuitive grace, Eddie is propelled into a world he initially can't begin to comprehend, running for his life from people he thought he could trust.

Director Andrew Davis, who is widely known for helming intelligent action thrillers like "The Fugitive," thought Keanu Reeves was the ideal choice to bring out Eddie's many facets: dedicated lab technician, fugitive from justice, unexpected hero.

**Rachel Weisz** portrays Lily Sinclair, a gifted physicist who is framed fro the murder of her revolutionary research team leader. ***Photo: Murray Close***

Says Davis: "Eddie Kasalivich is a great role for Keanu, someone who is crazy enough to ride his motorcycle in the frigid Chicago winter and, at the same time, is interested in the impact of this breakthrough technology. Keanu himself has a rather sophisticated interest in the world."

Along with his leading man qualities, Reeves indeed brings a strong social conscience to his numerous projects, and was allowed the opportunity to exercise both traits in CHAIN REACTION. He could also handle the physical demands of the role along with projecting the innocence and sensitivity Eddie has about science and its place in the world.

"I was attracted to the journey that Eddie has to take," adds Reeves. " He is a young man who has to come to terms with what he is actually participating in by creating this new technology. Suddenly, he finds himself involved with the government and big business."

Eddie's mentor is Paul Shannon, a mysterious figure who runs the organization funding the energy project. Casting the role of the complex, shadowy bureaucrat could have been a challenge, but Davis soon found the perfect actor. Davis admits: "I had always admired Morgan Freeman, and I discovered he is probably one of the greatest actors I'll ever have a chance to work with. He's a gifted collaborator, an inspiration to others, and a wonderful human being. In spite of some very tough conditions, he made everything easy for all of us."

Adds executive producer Richard D. Zanuck who, through his own distinguished career as a motion picture executive and Academy Award-winning producer, has worked with many of Hollywood's greatest actors: "Morgan always adds a sense of legitimacy, a sense of honesty, to any project in which he's involved. Only an actor of Morgan's great credibility could put across Shannon's ambivalence and complexity."

Freeman, in turn, appreciated the chance to play a character with many different shades. "Shannon is a very interesting man," the actor notes. "He is an extremely wealthy individual with very high-echelon contacts, who has a lot of power. Couple all of that with his relation-

**Morgan Freeman** plays Shannon, the mysterious head of a foundation backing a risky energy research project in ***"Chain Reaction."*** ***Photo: Murray Close***

Successful demonstration! **Keanu Reeves**, **Morgan Freeman** and the research team witness spectacular release of energy from water in ***"Chain Reaction."***

***Photo: Murray Close***

ship to Eddie and I saw a lot of possibilities with this role."

Shannon's questionable benevolence also affects Lily Sinclair, a young physicist who is comfortable with the quiet warmth of the Shannon-funded science lab. Then suddenly she is thrust out into the cold with Eddie Kasalivich, a man she knows only as a colleague but with whom she ends up entrusting her life. British newcomer Rachel Weisz, who was recently seen in Bernardo Bertolucci's lush drama "Stealing Beauty," was cast as Lily, following a long search by the filmmakers. Weisz describes Lily this way: "My character is a highly-qualified physicist who has spent her life buried in books— she's not very streetwise. I used to tell Keanu he was the medieval knight rescuing this bookish damsel in peril. But, she's a fast learner who soon graduates from damsel in distress to his right hand man."

***The world of science plays a big role in the film, introducing the audience to such concepts as "hydrogen energy" and "sonoluminescence."***

Some of Lily's and Eddie's life-and-death situations came from the imagination of CHAIN REACTION producer (with Andrew Davis) Arne Schmidt, who created and developed the idea for the story. In addition to the film's powerful action-thriller elements, Schmidt sees an important underlying theme. "Eddie Kasalivich is a metaphor for people who trust the system and never question the consequences of their actions," Schmidt relates. "Eddie realizes that he can no longer work blindly, no matter how important the project. He must learn to question everything and everyone, even his own mentors Shannon."

**ABOUT THE PRODUCTION**

Director Andrew Davis chose to shoot the film in Chicago, his home town, because it had all the components he needed to create CHAIN REACTION's mix of non-stop thrills and high-tech espionage.

"Chicago is the greatest backlot in the world," Davis claims. "It has world-class actors and crews, as well as incredible architecture. It also has a large scientific community, including two national laboratories, one of which was used as a location. There are major universities here conducting cutting-edge scientific research."

In addition to its modern-day technological havens, the city's scientific heritage was another draw: "The atomic age began on the campus of The University of Chicago, under the stands at Stagg Field, where Enrico Fermi produced the first atomic chain reaction," reminds Davis.

Keanu Reeves was impressed with his directors physical and political knowledge of the Windy City. "I took the Andrew Davis tour of Chicago," remembers Reeves.

"Every time I went into a building, Andrew would know who built it, what other buildings they built, and who was the politician involved. Andrew is a political man, especially in Chicago. He knows its history. His take on Chicago, and on the U.S. itself, is obviously very important to the movie."

The "history" and tradition of Chicago weather where snow, cold and wind chill all play leading roles was also a major influence on the production. The filmmakers expected a certain amount of harsh weather and snow to give the film a particularly dangerous harrowing look. But they got more than they bargained for.

"People kept telling me nobody is crazy enough to film Chicago in the middle of winter," Davis relates, "especially to do an action thriller on ice, metal bridges, in abandoned steel mills, and in subterranean tunnels. But CHAIN REACTION is a survival movie. It's a struggle, a dangerous and scary journey. Shooting it in the middle of winter gave it more energy, more of an edge."

The extreme weather conditions proved a daunting obstacle even to professionals used to dealing with Mother Nature's precarious ways. It was difficult to predict how a motion picture crew would handle sub-zero cold, but the CHAIN REACTION team was more than up to the task. Remembers Davis: "During the course of one day and night, it was so cold that the Chicago Fire Department notified its personnel to stop working with us unless it was an emergency— and there we were, still shooting. Some scientist friends, who were members of research teams based at the South Pole, sent an e-mail telling us that it was warmer there than it was in Chicago. They would work outside for one hour at a time, and there we were working in Chicago for six hours without a break."

With temperatures hovering at record lows, mechanical equipment, including beepers, cellular phones, and cameras, began to freeze. It became a full time job on some days to keep the cameras warm and working.

The cold weather certainly took its toll on Morgan Freeman. "It was difficult for everyone, particularly for me because I'm tropical," he points out. "I don't do cold weather. This is Chicago ... in the winter. I was actually ill and in bed, four days at a crack. It was really rough."

Despite the brutal conditions, the CHAIN REACTION cameras did record some of the most spectacular action set pieces in recent memory. One of the film's most formidable and breathtaking scenes is a furious chase up Michigan Avenue and onto the bridge. With helicopters flying back and forth, wind whipping around

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**Keanu Reeves** scrambles up the incline of a bridge to escape hordes of pursuing poicemen in ***"Chain Reaction"***
***Photo: Murray Close***

him, Eddie Kasalivich, fleeing the pursuing local and federal agencies, makes a desperate run up the Michigan Avenue Bridge . . . just as it begins to open.

That, however, was just the beginning of that sequence's challenges. At one point, Reeves' Eddie Kasalivich makes a dizzying climb from the first level of the icy, open bridge down to the second level. The sequence was choreographed by veteran stunt coordinator Walter Scott, who worked out every move with stuntman Billy Morts before the fearless Reeves performed the stunt himself.

Says Davis: "Because of the danger and logistics involved in a scene like this—the raised bridge, helicopters, boats in the river, and hundreds of people employed as extras—you can't shoot it 17 times from 17 different angles. You do it three times with five different angles and you make sure you get the shot."

Another hair-raising action sequence took place in Wisconsin on a frozen Lake Geneva. Eddie and Lily are forced to escape on a boat when the police begin to close in on them. As they make their escape, numerous law enforcement officers try to track them down by land and air.

"I always wanted to film this sequence on the frozen lake," Davis explains. "Everyone kept telling me that the river would be melted by the time we got there to shoot. They told me there was a danger of us falling through the ice, and that I would never get an ice boat to sail on the lake. Well, we were lucky. When we got there, the lake was still frozen and we found a fan-driven rescue craft from the Everglades being utilized in Wisconsin. That fire boat, with its bulletproof bottom which protects the hull from the ice, was able to fly across the frozen lake at 90 mph."

In addition to the characters taken on by CHAIN REACTION's much lauded and distinguished cast, the world of science plays a big role in the film, introducing the audience to such concepts as "hydrogen energy" and "sonoluminescence." In the story, Eddie and Lily's team of scientists discover a way to extract hydrogen from water inexpensively. They use a process known as sonoluminescence, which is the method of trapping intense sound waves in liquid, producing single bubbles of gas containing so much energy they are bright enough to be seen in a darkened room.

**Andrew Davis** directs the fast-paced thriller, ***"Chain Reaction."***
***Photo: Deana Newcomb***

To lend an important feeling of authenticity to this process, as well as to their roles, Davis arranged for Reeves,Freeman, and Weisz to immerse themselves in the world of energy production. "Keanu and I, and some other members of the crew, spent two weeks in the laboratories in Chicago. We got to hang out with all these scientists. They took us through many of the experiments on which they were working," says Weisz.

Wishing to give his character, Paul Shannon, even greater depth, Morgan Freeman seized a wonderful opportunity to debate the politics of alternative energy research with top scientists and the director of Argonne National Laboratory. Joined by Davis and Reeves, Freeman tossed ideas and opinions back and forth for several hours with some of the nation's foremost energy researchers.

An actor known for his meticulous and careful preparation, Reeves thoroughly enjoyed his time with the area's men and women of science. Equally intriguing to the actor were the political aspects of the research, some of which involved learning from some decidedly non-scientific types. "I worked with CIA agents," says Reeves. "I also got the chance to find out how research money is spent, what's being developed—and why."

Davis adds, "The actors did a great job researching their roles. Keanu wanted to understand what it would be like being a young machinist working with physicists, so he immediately befriended some physicists from the University of Chicago."

Production designer Maher Ahmad, who has frequently collaborated with Andrew Davis, also immersed himself in this world of cutting edge science while scouting familiar Chicago locations and landmarks. Davis' quest for realism led the production to work at actual locations whenever possible, as well as on sound stages.

Searching for that realism, Ahmad began his research three months before CHAIN REACTION began its official preproduction. "Initially most of my researchwas done in Southern California," says Ahmad. "I visited quite a few worldrenowned laboratories, including Lawrence Livermore National Laboratory, General Atomics, and Rocketdyne. I consulted with a number of scientists about

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the whole notion of our theme: creating hydrogen fuel. I had the opportunity to look at lot of facilities involved in this kind of work."

A key Chicago location was Argonne National Laboratory, run by the University of Chicago, one of the Department of Energy's largest energy research centers. There, the production filmed the story's critical C-Systems laboratory scenes, where Eddie and the forces which have been relentlessly pursuing him have a climactic showdown. More than a few cast and crew members noticed that they were filming in a building that housed part of the now defunct "Star Wars" program sponsored by the Reagan and Bush Administrations.

Finding a location for one of the film's most explosive moments, an incredible blast which levels eight Chicago blocks, proved one of the production's most formidable tasks. But, to comply with Davis' insistence on realism, such a site had to be found. And it was.

Remembers Maher Ahmad: "We heard about a steel mill on the south side of Chicago that was in the process of being completely torn doves. We arranged our schedules so that we would be filming as they were destroying some of the buildings."

An interesting juxtaposition of high-tech and low-rent was provided by the laboratory set where Eddie and Rachel and their colleagues achieve their tremendous breakthrough. Situated inside an old, rusting piece of industrial technology that was once a steel mill, the laboratory was equipped with enough state-of-the-art scientific equipment to make any researcher happy.

CHAIN REACTION's mix of heart-stopping action set pieces, brutally cold weather and formidable locations were a challenge to all the cast and crew. Andrew Davis perhaps best sums up the filming experience: "I sometimes felt that the experience of shooting this film was like being caught in a war; at other times I felt like we were part of a troupe of troubadours and actors, bundled up, traveling through Czechoslovakia in the Middle Ages. That's what making movies is, a blend of carnival and warfare."

***BREAKING SYMMETRY is about trying to stay alive while uncovering the truth.***

# BREAKING SYMMETRY

**Keith Johnson**
Writer, Producer & Director
ARCHIMAGE
PO Box 380792,
Cambridge, MA 02238-0792

A brilliant young female astrophysicist uncovers a conspiracy to sabotage experiments leading to cheap environmentally safe energy for the world. She faces the life-threatening danger of this knowledge, while struggling to have her own research recognized at a male-dominated technical institute.

What if a startling scientific discovery were announced that could, by implication, help eradicate many of the world's problems: environmental degradation, global warming, poverty, hunger, disease, and economic stagnation?

In 1989, two world class electrochemists, Stanley Pons and Martin Fleischmann, mesmerized the world with the claim that cheap, environmentally safe energy could be generated from water, one of Earth's most abundant natural resources, using a simple electrochemical cell, thereby marking the beginning of the end of the fossil fuel age and the end of fission nuclear power. This experiment came to be known as "cold fusion." After months of work by several prestigious U.S. laboratories failed to reproduce the effect, most American scientists and the U.S. Department of Energy rejected the idea.

However, cold fusion wouldn't go away. In 1992, a number of respected Japanese labs announced they had repeatedly produced significant amounts of "excess heat" energy from cold fusion cells of their design. The Japanese government has committed millions of dollars for research on this phenomenon, which they call "new hydrogen energy." Many private Japanese companies are actively engaged in "cold fusion" research. One of these, a subsidiary of Toyota Motor Co.. has set up a fully-staffed lab near Cannes, France for Pons and Fleischmann. Their ultimate objective: "cold-fusion" water engines for cars, home heating devices, and industrial power.

Nevertheless, the official "thumbs down" policy regarding "cold fusion" by the U.S. Department of Energy and vested interests in competing fossil fuel and nuclear technologies persists today.

The feature film, *BREAKING SYMMETRY*, is a fictional "thriller" in which the real science drama and controversy surrounding "cold fusion" are major plot elements. Set against the backdrop of academia, the story is about what happens when CAROLYN WILLIAMS, a young female professor of astrophysics studying "cosmic dark matter," discovers a videotape containing the real secret to "cold fusion." As she unravels the secret and connects it to the murders of two senior faculty members, she becomes the target of a conspiracy to protect vested university, industrial, and government interests and keep the new energy technology from being commercialized. The film reaches its explosive conclusion onstage at a science convention, where Carolyn reveals the truth about cold fusion and its connection to cosmic dark matter. BREAKING SYMMETRY is about trying to stay alive while uncovering the truth. Suspense, conspiracy, action, and romance. They're all in BREAKING SYMMETRY.

Principal photography has commenced in the Summer of 1996, in Cambridge, Massachusetts.

**MIT Professor Keith Johnson, writer, producer, and director of *Breaking Symmetry***
**(Photo: Donna Coveney, MIT News Office)**

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# An Interview with Dr. John O'M. Bockris and Dr. Hal Puthoff

*(Transcribed by Jed Rothwell)*

## 21st Century Radio's Hieronimus & Co.
## Cold Fusion Special June 23, 1996

***On June 23, 1996, Dr. Bob Hieronimus conducted a live radio interview with Dr. Eugene Mallove, Professor John O'M. Bockris, and Dr. Hal Puthoff. What follows are transcriptions of the separate interviews with Drs. Bockris and Puthoff:***

**Hieronimus intro:** *Dr. John O'M Bockris is a distinguished professor of chemistry at Texas A&M University. His research interests are in the areas of quantum electrochemistry, photo-electrochemistry, electro catalysis, and bio-electrochemistry, corrosion, the splitting of water and low temperature nuclear reactions. Bockris organized a significant research group in electrochemistry at the Imperial College, working particularly on the basic techniques of measurement of electrodes, and also in the field of high-temperature liquids. He emigrated to the United States in 1953, and in 1954 was appointed professor of chemistry at the University of Pennsylvania. During the 1960s Bockris led the largest electrochemical group in the western hemisphere. His best known book, Modern Electrochemistry, was written with A.K. Reddy during that time, and published in 1970. In 1972 Bockris was appointed to the chair of physical chemistry at the Flinders University in South Australia. There he became the chairman of the Institute of Solar and Electrochemical Energy Conversion, and he wrote the book titled The Solar Hydrogen Alternative. In 1974 Professor Bockris was made a member of the Swedish Academy of Engineers, and the Serbian Chemical society, also in 1979 he became the first recipient of the Faraday medal, an award made by the Faraday Division of the Chemical Society. He was given the Chemical Award of the Swedish Academy in the same year, and numerous other awards.*

**Hieronimus:** John, you note that in the first years of this century, it was thought that atoms were indivisible entities until Rutherford found that a great deal of an atom was free space, and at the center was concentrated nearly the entire mass of the atom. He struck $N_2$ gas with an energetic stream of alpha particles (helium nuclei) and produced $^{17}O$ from $^{14}N$. Tell us what significance this has to the mindset which believes that to break into nuclei, you need about a million times more energy than is given out in a chemical reaction.

**Bockris:** I think that Rutherford's work was the beginning of what we call now high energy physics. This is a very large part of physics, and it has that basic assumption – that you need enormous energies. Now what has happened in the last five or six years is it's been found that nuclear reactions can be made to occur, as long as they occur inside solids, with rather small energies. Instead of having to strike them with these enormous energies which cost so much to set up and to have apparatus, you can do it all for $10^{-4}$ (as it were) the price. That's the great important thing. The cost comes down and one can obtain nuclear reactions under very, very simple conditions.

**Hieronimus:** From that you concluded that it was a general lack of knowledge of these things that you just mentioned, concerning being able to split nuclei with much less energy, that caused the furor against Fleischmann, Pons and Hawkins when they suggested that palladium heavily loaded with deuterium was the site of a nuclear reaction. Would you please flesh out this conclusion for us?

**Bockris:** Yes, the major part of the story since 1989 has been with palladium. I don't think it is the only part at all; I think these reactions occur rather widely. But 90% of the work has been done with palladium-deuterium, and the evidence that nuclear reactions occur in it under electrochemical conditions is largely the production of tritium and the production of helium. Both these substances are very, very unusual materials, and it is very difficult to see how they could be produced in a normal way. They are enormously expensive to produce classically, as we call it, by the normal means. And, incidentally, tritium is used in atomic bombs and is a very important military supply. It costs a million dollars an ounce.

**Hieronimus:** Oh!

**Bockris:** The calculations show and the experimental results show, that tritium could be produced for a very small fraction of that money. So of course it means a great deal to the DoD and to the economy in general. As far as the "heavily loaded" is concerned, what that means is that if you put the deuterium into the palladium nothing happens – nothing anomalous, nothing nuclear happens, until the deuterium is very nearly up to one deuterium atom equals one palladium atom. It is a tiny bit less than that: about 0.95 deuterium to 1 palladium, then you begin to get nuclear reactions. They continue for some time, often for several weeks. They die down, and you have to have fresh palladium etcetera.

The furor I think was due to two things. On the one hand I think a great deal of the emotion which went into it in 1989 and '90, was sheerly emotion. I think that people were . . . the old people were arrogant and they thought they had it all, and they thought they had to have these enormous energy releases, and when it was proved that you could do it very simply, with lesser energy, they were very very annoyed! *(Laughs)*. But there was also what you might call a more objective objection on their side, which I, as a researcher fully understand, and that is: you can't go into a laboratory with this kind of thing and say "hey guys, I am going to show you," and switch it on. It is a very difficult thing to hit the "right wavelength," as it were, and I would say on the average only about one experiment in five does it. It is rather like finding a radio band on the radio. You have to search around for it and then you get it – bing! – it switches on and things happen. Unless you hit those conditions very, very completely, you don't get anything at all. So a lot of people tried it and they did not get anything and they said, "oh this is nonsense." And those people who hung on and tried harder, so to speak, did find the tritium, find the helium, find the nuclear reactions. They were successful.

**Hieronimus:** I was going to ask you to talk about three models in which barriers between nuclei can become transparent. Let us bypass that question in the interests of time, because I have a lot of other questions. Would you discuss the conclusions in your paper "Two Zones of 'Impurities' Observed after Prolonged Electrolysis of Deuterium on Palladium" (*I.E. #5 & 6*)?

**Bockris:** Yes. This was something we did rather recently, where we put deuterium into palladium and we looked for impurities which would accompany this act. The solu-

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tions we were using had certain impurities in them, and we found these impurities were adsorbed upon the surface, and they penetrated about 50 angstroms below it. But when we probed further with various techniques we found that a new series of atoms had turned up. Atoms which, indeed, were not present at all before we began and were not present in the solution – that's the point. So we concluded that these atoms had come via a transmutational process. Transmutation means the formation of one nucleus into another nucleus. Since that time – I think we did this about a year ago – a number of other people, particularly people at the University of Illinois [Dr. Miley et al.] have come up with further evidence that this does occur when you put deuterium or hydrogen into palladium, you get new nuclei, and that is of course transmutation in the cold.

**Hieronimus:** On that subject of transmutation, I understand from your conversation with Chris Bird some very limited success was obtained at transmuting some elements into gold. After a break here, we'll talk about that next, and then we'll get into tritium because you were the first to find it in 1989 in the cold fusion process.

**Bockris:** Right.

**Hieronimus:** And you believe that Fleischmann and Pons should get the Nobel Prize for transmutation. We'll talk about that. And then I want to talk a little bit about Texas A&M trying to label you as a fraud, attempting to destroy your reputation.

*[Break for commercials]*

**Hieronimus:** I understand from conversations with Chris Bird that some very limited success was attained at transmuting some elements into gold. Would you please review that scenario, and why you ceased research into that area.

**Bockris:** Yes. Well, we were approached by some people who claimed they had a technique for doing this. [Telander and Champion; the method is classic thermal alchemy.] They wanted us to try it out. We of course started off by telling them that they themselves mustn't be in the laboratory and only our own people could do it. So I had two postdocs and a graduate student try this process out. And indeed, in very small quantities, around 100 parts per million, we got four consecutive experiments which did give – seemed to give, to all intents and purposes – the transmutation of small amounts of lead and mercury into gold, ruthenium, osmium, etcetera. However, when we went on with this, later, we couldn't reproduce it, so we had to withdraw. But I'm fully convinced that in the four experiments that we made we were producing these small amounts. Since then, numerous people have done similar things, but usually with other metals.

**Hieronimus:** Uh, huh. In regards to tritium, you were the first to find it in 1989 in the cold fusion process. What is the importance of this? Why is it a gigantic step?

***The way that we make tritium at the moment – and tritium is vital in atom bombs – is a million dollars an ounce. And it can be made in the laboratory in a very simple apparatus for much less money.***

**Bockris:** Oh, well that's very clear. Tritium is a gigantic step. It is the real proof that cold fusion, as they call it, exists. You may say "as they call it" because I am not too sure about the mechanism and I think it might be a fission reaction instead of a fusion reaction, however both would be nuclear. And no classical chemist, the type that goes along with the chemistry in the book, would have expected that tritium would have been formed. That's why it is such a gigantic step. They all thought it was totally impossible. And of course, as usual, tremendous amounts of money are associated with all of this. The way that we make tritium at the moment – and tritium is vital in atom bombs [Tecnically, in thermonuclear bombs—hydrogen bombs. Ed.] – is a million dollars an ounce. And it can be made in the laboratory in a very simple apparatus for much less money. So of course people were very surprised. I was accused immediately – and that's the usual reaction to these things – of fraud. It was said that the tritium was obtained by a graduate student putting it in from a bottle of tritium.

**Hieronimus:** That's an amazing thing to say, without any proof!

**Bockris:** Well . . . there was a very, very aggressive journalist who wanted to make a name for himself and sell his book, and he came along and said all sorts of terrible things. Threatened the student with instant exposure and so on . . .

**Hieronimus:** Is this the fellow by the name of Taubes?

**Bockris:** Taubes, that's right. And after that I called all kinds of advisors and said "should I sue? Would it be right to sue this man? Would it be profitable? Or sue the company that published his book?" And every one advised me, well five out of six of my advisors – the sixth did advise suing – but five out of six said, "relax, relax. Your work is either going to be proved right or wrong. If it is proved right, you don't have any more worries." And since the time that I first claimed tritium, just about 120 papers have been published – and I stopped counting after 1994 – 120 papers have proved that . . . confirmed those first readings. So I am completely convinced and completely happy. On the other hand of course, you know the mud always sticks.

**Hieronimus:** Indeed.

**Bockris:** There are all sorts of people who read that original article said it was all fraud, they haven't seen the 120 papers.

**Hieronimus:** That is the major problem. The major media is not sensitive to this particular area and I don't think they are going to correct their errors.

**Bockris:** We tried at the time to publish data, and prove there was no fraud, but they wouldn't hear of it. They said people weren't interested in the disproof.

**Hieronimus:** (*Laughs*) I know, I know. I am sorry for laughing John, but it is just so pathetic, that they can make such an enormous error . . .

**Bockris:** Yeah . . .

**Hieronimus:** . . . and then figure, ah well, it is not news, so we don't have to correct it.

**Bockris:** These are not just newspapers, these are the magazines of science.

**Hieronimus:** Indeed.

**Bockris:** One of the most prestigious magazines in the country, and it wasn't only I, but others from Los Alamos wrote in and said that they had seen the tritium too and it was all true. But they were told "no, our readers are not interested in that. We have published the fraud [story] and they are interested in that."

**Hieronimus:** (*Laughs*) Boy, nothing like protecting the status quo. Now, Texas A&M tried to label you as a fraud. Tried to destroy your reputation at the highest levels of the university. I know this is a painful thing for you to discuss, but I would love to get it on the record here. Review for us what happened.

**Bockris:** Time is short, but I'll just try to summarize it all for you. I was first of all accused of scientific misconduct, and hauled out between four of my peers. I'm called a 'Distinguished Professor' – the highest rank of professors here – and I was tried, as it were, in front of four of my peers: four Distinguished Professors. And the result was I was totally exonerated. But

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you know that was after three months of tremendous anxiety, employing lawyers to advise me, and so on and so on. And then after I had been accused of misconduct and totally exonerated, there was then a number of colleagues in the department of chemistry who wanted to go further and they instituted a secret committee. My lawyer asked what's it doing, what's it about, they said oh well, it is to see if there should be any reassignments of duties, or any [inaudible] fines of professors. That was the aim of this committee. That lasted for eleven months. Eleven months of torture. In which my wife and I knew not anything about our future.

**Hieronimus:** That's amazing.

**Bockris:** We eventually appealed to the Association of University Professors, and directly after we had done that, and exposed our case to them, the university came forth and said they had found I had done nothing outside the rules of the university. And as far as I know, that's it. But, you know, this was a period of sheer persecution.

**Hieronimus:** As you know, and others have noted too, the same thing happened to Dr. Robert Jahn, at Princeton.

**Bockris:** Exactly. I think I met Robert Jahn for the first time the other day, at the meeting in Charlottesville, Virginia, of the Society for Scientific Exploration. What he has done of course is to show that minds influence machines.

**Hieronimus:** Uh, huh. Yes, indeed.

**Bockris:** When you look at a pendulum, which is swinging at a certain rate, you can make it go faster or slower by looking at it. That's of course a thing that scientists would never believe at all. The unfortunate thing is they don't believe facts. They believe old theories.

**Hieronimus:** Well, let's see, I am trying to remember. Dr. Henry Bauer in his work pointed that out so well. He has been with us a number of times. What do you think is at the bottom of the persecution of leading-edge researchers?

**Bockris:** Oh, I am very clear about that! It is simply fury and envy. You see, every scientist in the top rank is kind of boxed in to a monetary system. They are getting good fees in consulting, they are regarded as authorities, and suddenly something comes along which is totally different from anything they had ever thought of before. And . . . well, they didn't think of it. So of course the thing to do is first of all, prove it fraudulent. That's the best thing they can do, because that would completely expunge it. And if they can't prove fraudulent then they will say it is all due to wrong measurements. The measurements must be crazy and so on and so on. But the basic motivation behind it every case I am sure is envy and fury at having been scooped.

**Hieronimus:** Yeah? I think you are absolutely correct there, sir. Uh, going back to cold fusion now, and its practicality. What do you see as a reasonable timeline for when cold fusion products will come on line?

**Bockris:** Well, I've thought about that. You can . . . it is hard to guess. Now, if you want to be very positive about it, you can say that there are now advertisements arriving, particularly from Moscow, that talk about household heaters which need refueling every thirty years. And the only way to explain those advertisements – they don't mention the word ' cold fusion' – is that these are cold fusion heaters. Because the only way you could have a nuclear thing – I mean it has to be nuclear for refueling every thirty years – in the household, would be a cold fusion one which doesn't produce any harmful waste. So if you believe that advertisement, that they really have these things, there is something practical now. There is a company called ENECO, which works out of Salt Lake City, and they believe that they have some devices which they can sell right now. As to when the universities will accept it . . .(*laughs*) another fifty years, I would say.

**Hieronimus:** Oh, John, don't say that! (*Both laugh*) Its sad but . . . (l*aughs*) you know, America had changed . . .

**Bockris:** Well that's . . .

**Hieronimus:** . . . so much, since the mid 1970s.

**Bockris:** Well, I have been in this country since 1953 and I can remember the times when all new ideas were jumped upon with joy. This was so during the '60s, and I think into the '70s. But something died. I don't know, it is ridiculous to put a date on it and say it was 1972 or something, but something sometime in the '70s just all died, and it became frozen. Science has become frozen. Physics particularly.

**Hieronimus:** You believe that Fleischmann and Pons should get the Nobel Prize for transmutation.

**Bockris:** I think so.

**Hieronimus:** Could you explain why?

**Bockris:** Oh, well, because they have done something which completely changed the paradigm of nuclear reactions. Up to Fleischmann and Pons's time, nuclear reactions were – as we said at the beginning of this discussion – were seen in the context of Rutherford's work. I call it Rutherford's castle. You know, you had to hit it with some enormous sledge hammer, and then you might get a nuclear reaction to occur. Fleischmann and Pons showed that with a tiny "ounce of reaction," they can get a nuclear reaction to occur. So just as the famous people in the history of nuclear reactions are Meitner, Rutherford, Fermi, so I think the Fleischmann and Pons should be similarly regarded. I think they would come right out at the top. I think I have had a part in it too, but they started it, and I verified it – showed that it was so, but I think their initiative should be regarded in that way. I think it will be.

**Hieronimus:** What are you presently working on, that you would like to share with our listeners?

**Bockris:** Oh, well, I am working on a number of things. The main thing I am working on which is easy to communicate are "gree" chemicals. You know, the idea that a lot of chemicals are toxic. And we have to use them. The particular ones I am working on are corrosion inhibitors. A lot of the corrosion inhibitors are used in the North Sea [oil drilling] platforms are toxic to fauna. They knock the fish out. The fish decay and all sorts of things bad happen, and the oil companies have been threatened by the Norwegian government and the British government: "stop using corrosion inhibitors which are toxic." So I am being employed by a group of oil companies to invent corrosion inhibitors which are not toxic.

**Hieronimus:** Way to go, John! Way to go! Well, it has been a great pleasure talking with you again. I guess the last time we talked was about three years ago.

**Bockris:** Yes, it was.

**Hieronimus:** That's a long time ago. And I would have thought by now this whole problem would have been solved, John! (Laughs)

**Bockris:** Give it another ten or twenty!

**Hieronimus:** Yeah, the way it is dragging its feet. Well, we have some wonderful things we are going to be sending on to you. And I am so happy that we share some other areas of research and interest in common.

**Bockris:** Well, it is grand talking to you. You are so interested and enthusiastic about it.

**Hieronimus:** We will be talking to you again some time.

**Bockris:** Thank you very much.

**Hieronimus:** You are very welcome.

**[End]**

**Hieronimus:** Our final guest for this evening is Dr. Hal Puthoff, whose research in consciousness captivated our attention in the late '60s and early '70s. Our friend Ingo Swann has noted Hal Puthoff's importance to remote viewing research during

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his several appearances on 21st Century Radio, and we may touch on that subject later tonight, but we will be focusing most of our time on alternative sources of energy as in cold fusion, zero point energy, and nanotechnology.

Dr. Hal Puthoff is Director of the Institute for Advanced Studies at Austin, TX. He is a theoretical and experimental physicist, specializing in fundamental electrodynamics. His present research interests range from theoretical studies of quantum vacuum states as they apply to the availability of matter, gravitation, inertia and energy research, to laboratory studies of innovative approaches to energy generation. A graduate of Stanford University in 1967, Dr. Puthoff's professional background spans more than three decades of research at General Electric, Sperry, the National Security Agency, Stanford University, SRI International, and since 1985 as Director of the Institute for Advanced Studies at Austin. He has published over 30 papers on electron beam devices, lasers, and quantum zero point energy effects, he has patents issued and pending in the laser communications and energy fields, and is co-author of a Wiley textbook *Fundamentals of Quantum Electronics*. [R.H. Pantell, H.E. Puhoff, (Wiley, 1969)] Puthoff regularly serves various government agencies, the executive branch, and Congress as a consultant on leading edge technology and future technology trends. He is a member and officer of several professional organizations, he is listed in such biographical reference works as *American Men and Women of Science*, *Who's Who In Science and Engineering*, and *Who's Who* and has been designated at Fetzer Fellow in 1991. Welcome to 21st Century Radio and TV news Dr. Puthoff.

**Puthoff:** It is a pleasure to be here, Bob.

**Hieronimus:** Even though propagandists like Rush Limbaugh say that ecological disasters are nothing more than left wing media hype designed to tax big business, our environment is not in good shape. And yet there is a great deal of hope that new energy technologies can do a lot to keep us from entering an ecological no-return zone. Before we review cold fusion and zero point energy, would you assess, in general terms, the possibility that new energy technology could revise our environmental problems.

**Puthoff:** Actually, Bob, I am quite confident that will be the case. Before we knew of atomic energy, we thought we were running out of coal and maybe oil wouldn't last too long, and then we came upon atomic energy. Now as it turned out, atomic energy has its pluses and minuses, as you realize. But still, it was a new energy source that just hadn't been thought about before, but once we had it we could exploit it. I think at this time we are entering a new phase in which a lot of new energy research is going on, whether it is solar energy, wind energy, and so forth . . . but also the so-called zero point energy that we will be speaking about tonight. I think that holds out a lot of hope for the future environmental situation and that as far as we know it is a completely benign energy source. As far as ecological concerns go.

**Hieronimus:** Well, Gene Mallove, who says hello, says you are going to be very excited when you see the next issue of *Infinite Energy*, with Dr. Paulo Correa and Alexandra Correa's PAGD reactors.

**Puthoff:** I am looking forward to seeing that. I have heard of it, but I have not had a chance to look at the data.

***John Wheeler likes to point out that in the volume of a coffee cup, for example, in empty space, there is enough energy to evaporate all of the world's oceans.***

**Hieronimus:** Well, I was really excited when I read that. Now, we have spent most of our evening discussing cold fusion, so let us start our conversation by talking about zero point energy, and one of your papers I read recently. You stated that quantum theory tells us that empty space is not truly empty, but rather contains an enormous amount of untapped electromagnetic energy known as zero point energy or ZPE. Would you define this energy for us, please?

**Puthoff:** I'd be glad to. As you say, it is the energy of empty space. There were arguments starting way back at the time of the Greeks about whether space is really empty or isn't it. Democritus thought that it was empty and that is how you have room for the atoms to bump around. You had Aristotle coming along saying no, I think space is full of something because we have waves of heat energy and they must travel in something, That argument went back and forth but finally when quantum theory was developed, it became absolutely clear that space, if you look at in a microscopic scale, is more like the base of a waterfall with a lot of frothy, seething activity going on, rather than just something like a placid, empty space. In fact John Wheeler likes to point out that in the volume of a coffee cup, for example, in empty space, there is enough energy to evaporate all of the world's oceans. This is, by the way, not a fringe concept. It is a basic underlying concept in modern quantum theory.

**Hieronimus:** But where does this energy come from?

**Puthoff:** Well, it turns out that every particle in the universe has some charge on it, whether it is the electrons and protons in our bodies, or in the Sun, and then all the way out to as far as we can see throughout the cosmos. It turns out that all of these particles are undergoing a little tiny quantum jiggle, or quantum dance, and in that process they are radiating energy. Any given particle is jiggled about by that energy, and in turn radiates back, so what we have on a cosmological scale is sort of the electromagnetic equivalent to putting a microphone by a speaker and getting the squeal. We have a giant sort-of feedback system, with all the particles generating this quantum zero point energy, continually reinforcing itself, just like, for example, the squeal in the microphone.

**Hieronimus:** You have read *Beyond the Big Bang* by Paul LaViolette haven't you?

**Puthoff:** I have seen it, yes.

**Hieronimus:** What was your opinion of that book?

**Puthoff:** I think that although it is sort of counter to the prevailing mainstream view, these are the kinds of ideas that we seem to have a renaissance of these days. I certainly applaud his efforts to open up new ways of looking at things. I have not come to a final opinion as to whether I think he is correct about it. But I think this is the kind of probing and thinking that makes science today a very exciting time.

**Hieronimus:** Yeah, it sure does. Going back to zero point energy, can such energy be mined for practical use?

**Puthoff:** Up until about a decade ago, it was thought that the answer was no. The reason being that, for example, we are surrounded by heat bath – the temperature in here is say 75 – and physicists had learned by attempts to quote "mine heat energy" that it always took more energy to make use of [ambient heat] than you got out. So although we can do that with refrigerators and heaters and so on, you are having to pay an energy penalty as great as what you get out. It was kind of assumed that the surrounding zero point energy, which is everywhere, was maybe like a heat bath, and that you couldn't tap it. But back in '84 there was a researcher at Hughes laboratory, by the name of Bob Forward, who pointed out that there was an effect called the Casmir effect that in

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fact showed that on a microscopic scale it is both experimentally and theoretically confirmed that indeed some of this background energy could be turned into some other form. Once that was realized, then it was the case that the proof of principle was there, so now physicists and engineers like myself are interested in finding out how to do it efficiently, and what technologies you need to turn it into a market-viable energy source. To the people who are working in the field, it is now at the point of solar energy or thermonuclear fusion or whatever: the principle has been proved, it is a case of trying to find a viable way to do it.

**Hieronimus:** This I found really fascinating: that "inertia is a subtle feature of the structure of the universe, that has perplexed generations of physicists from Newton to Einstein." (Reading from Puhoff's paper.) That part I understood! But in an article for *The Sciences* you and your co-authors Bernard Haisch and Alfonso Rueda traced the problem of inertia as a zero point field Lorentz force. Please explain how this is.

**Puthoff:** I am glad to do that. This is one of the most exciting pieces of effort that I and my colleagues have worked on. Also, it solved a problem for us, which I think you would be interested in. Whenever we would pose the idea of tapping this energy, and that there was so much energy even in empty space right in your face so to speak, the question was always, well if there is all that energy there, why don't I notice it? And in fact it turned out that this study of inertia was the first case where you can actually talk to a layman and get him to realize that you do notice it. For example, if you are standing on a train or a bus, and it takes off with a jerk, and you suddenly find yourself flat on your back, it is as if a 200 lb man came up and knocked you down. So you have to ask yourself "what is it that actually knocked me down?" What it actually is, is that you ran into that wall of zero-point energy and it held you back, and knocked you down. So the next time you are on an airplane and find yourself pressed back in your seat, you are actually feeling you might say the wind from the vacuum zero point energy. This vacuum Lorentz force – that term is just a standard term for a magnetic force that engineers are familiar with in the laboratory – and whenever you have a charged particle moving through a magnetic field it feels the force. Well, it turns out that the magnetic field associated with these zero point fluctuations is always there and since our bodies are made up of charged particles – even the neutrons that are neutral are made up of charged quarks – it turns out that they feel the Lorentz force. Whenever you try to accelerate a body there is this resistive force that holds you back, and that is what we experience as inertia. So when you are trying to move your car down the street when its battery has gone dead, all that effort it takes to get it moving is the fact you are actually pushing against the vacuum. Unlike an ordinary wind, just moving at constant velocity, you don't feel this force at constant velocity but you do feel it whenever you are trying to accelerate or to accelerate an object.

**Hieronimus:** Okay, here is a big question. Quantum fluctuations of distant matter structure; the local Lorentz invariant vacuum fluctuation frame of reference, and acceleration relative to this frame results in the retarding force that we label 'inertia.' Now you note that the implications of this discovery are far reaching in regard to gravitational effects in general and gravitational mass in particular. Please review this conclusion for us.

***The next time you are on an airplane and find yourself pressed back in your seat, you are actually feeling, you might say, the wind from the vacuum zero point energy.***

**Puthoff:** As you noted, this concept of inertia and gravitation is something that has been struggled with by physicists since the times of Mach and Einstein and Newton. Up until now, generally we have assumed that gravity and inertia are just something we are kind of stuck with. That it is there: that's it, we cannot do anything about it, no one is making any anti-gravity machines, we are not getting rid of inertia for our spaceships, that is just what we deal with. So even with the developments in general relativity by Einstein, which have been extensive – we now understand certain concepts about space being curved and that tells particles where to move, and so on – still, that has been at the phenomenological level. When we started our research into the zero point energy underpinning of these kind of phenomena, the thing we realized is that gravity, inertia, and a number of other phenomena are really consequences and results of this underlying energy bath, you might say, that we are in. And so, having that knowledge and developing some equations about what effects it has, we are now at a point where we can consider: okay, if we understand how gravity is produced by this underlying energy, and if we understand how inertia is a consequence of this underlying energy, we can now ask new kinds of questions. Can we manipulate this energy? And the answer is yes. And if that is the case, then isn't there the possibility that we might someday be able to induce gravitational effects or counter-gravitational effects, or reduce inertia, and so on. We come at a level below the usual view, where rather than just saying: well, we are stuck with gravity as it is, or stuck with inertia as it is, we have now gone to a deeper level where we can possibly talk about manipulating these forces. And of course, that has very broad implications.

**Hieronimus:** Maybe we can later touch on what kinds of implications those would be, in space travel. You also note that "probably the most important aspect of the discovery of the intimate connection between inertia and the vacuum fluctuations is that the number of independent physical concepts upon which the structure of modern theory is built is reduced by one." Why is this so important?

**Puthoff:** Every time we advance scientific theory by reducing the number of things we think are out there, it gives us an understanding that lets us begin to first of all more deeply appreciate exactly what is going on, and secondly begin to get an engineering handle on how to manipulate something. Back in the old days, it used to be thought that heat was a separate kind of fluid force that inhabited bodies. Some were hot and some were cold, and so on. At that time, without the understanding, it was difficult to, for example, come up with the idea of building a steam engine. But then as we reduce the number of independent variables we realize that heat really has to do with simply the amount of energy that, say, gas molecules happen to have as they run around and bump into each other, and bump into the walls, and as we gain that understanding we can then start thinking about how can we use that force to push on a piston and build some kind of engines. People come at it from different standpoints. In some people's minds, just reducing the number of variables and cleaning up our understanding is a very esthetic and captivating enterprise, but to those who are practical minded, it also means that you have a chance to do some engineering and having some fun making things.

**Hieronimus:** Uh huh. Well, now we can get to some cold fusion. Earlier tonight, we reviewed the progress being made in cold fusion with Dr. Mallove and Dr. Bockris. From your perspective, what is cold fusion? Is it a fusion process?

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**Puthoff:** I guess at this point, I may have a minority view. I don't actually think that it is fusion. One of the complaints that people have about fusion is that all that heat coming out I would expect – one would expect – there to be a lot more radioactivity, a lot more neutrons, x-rays and so on, and yet the amount of actual heat that comes out is extraordinary, at least as claimed in some experiments, in comparison to the number of so-called fusion products. So, I am entertaining the possibility that although there may be some low level fusion going on, and certainly Professor Bockris going over the data on the transmutation of elements makes it look as if there is some fusion going on, I think though that it may be possible that the greater amount of heat energy coming out is a result of a zero point energy extraction process. And there are a couple of researchers in addition to myself who have been trying to work out the theory of how that might be the case. I think that so-called cold fusion phenomena are very complex and may involve more than one process. Of course, being a zero point energy chauvinist, I think it is zero point energy. Maybe I can be forgiven for saying 'well cold fusion is probably from zero point energy' but actually we have gone beyond that, and we have made some predictions we are trying to check out in the laboratory. I think at this point, to be honest, we just have to say we do not yet know what this phenomenon is. We know some of its characteristics. Probably because of the transmutations, some fusion may be going on, but in terms of the extraordinary amount of heat, although there may be some new nuclear processes that we do not understand yet, that are responsible for the heat, there are also some good arguments why zero point energy may be being released as well.

**Hieronimus:** Do you believe cold fusion is going to be commercially controlled by someone like, say, the power companies?

**Puthoff:** That is really a tough question. Um . . .

**Hieronimus:** Well, you get extra points if you get this one!

**Puthoff:** I've got some answers to it. (*Laughs*)

**Hieronimus:** Okay!

**Puthoff:** As it turns out, the cold fusion process, or if I can even broaden it out to include the zero point energy processes, some of the experiments in which these effects apparently are seen are really sort of garage level experiments. If someone hits on a good, solid, robust embodiment, this is the kind of thing that I think you would find a lot of people could be dealing with in their garages, and at least for small scale applications not going to the power companies. Now I think that since power companies do have a large economic structure and so on, I think they will of course get into it as anyone else would, but I think that it is sort of like ham radio: yes, there are commercial radio stations but you have a lot of ham radio operators out there building their own rigs and talking to each other and so on. I think there is a chance more like in wind energy and solar energy where there will be smaller scale entrepreneurs who may actually feed energy into the grid as the wind people are doing at this point. So I think that although the power companies may get involved at some point I think you will see also sort of smaller scale entrepreneurial activities going on....

***I think that so-called cold fusion phenomena are very complex and may involve more than one process. Of course, being a zero point energy chauvinist, I think it is zero point energy.***

.....

When the idea of the hydrogen atom was first put forward in the form that you often see it on textbook covers, where it looks like a tiny little solar system with the electron planet circling the nuclear sun, one of the questions at the time was: why doesn't the electron simply radiate its energy away and spiral into the nucleus, in a way similar to the way our satellites have certain losses and spiral into the planet? At the time, the answer was simply, well it is just the magic of quantum theory, it doesn't obey classical rules, and for some reason hydrogen atoms are like little perpetual motion machines. But in fact, from the standpoint of the zero point energy approach, we now recognize – and the calculation has been done, in fact I published on it myself – we show that indeed you expect an electron in a hydrogen atom to radiate its energy away, but it picks up energy from the background zero point energy and therefore is sustained by it. What that means in terms of physics is that is shows why atoms can be seen as perpetual motion machines, it is just that they always have an energy input from the background to make up for the losses. One of the embodiments of cold fusion we are looking at is the possibility that when hydrogen atoms enter into metal lattices the conditions for that balance change. And as a result, calculations can be done to show that some energy is released. There you have a case where by playing very smart with the hydrogen atom you have a chance to change its orbit under certain conditions and possibly getting a release of energy.

**Hieronimus:** You mentioned that you do not believe that cold fusion is going to spell the end of power companies. In your conversations with Chris Bird you noted that the Arab oil producers in the Middle East should be brought into the investment picture, which I thought was really interesting as to why. Because that would keep them from standing in its way.

**Puthoff:** That's exactly it. In our business plan, under the assumption that we might really bring this to market, we have looked at all the potential "enemies" and in every case there is a way to work out a win-win situation. And so, in terms of talking to the ordinary oil companies here, I had a chance to talk with Scotty Hahn, president of Penzoil, and research directors and presidents and vice-presidents of a number of other oil companies, talking to them about the zero point energy future. They said they would definitely welcome it, because right now if they take oil out of the ground and make pharmaceuticals and plastics they have a big profit margin, and they do not use much of the resource. But when they put it into cars and homes it is sort of like burning Van Goghs and Picassos to heat your house.

**Hieronimus:** Indeed.

**Puthoff:** They said you wouldn't have any trouble with us, but you might have trouble with the people who get it out of the ground. So there our approach is simply to go to them and let them know this is happening. If they capitalize the development of it then as oil goes down their investments will still win.

**Hieronimus:** Well, we are running out of time and I had many more questions. Let me ask one. Consciousness is the key, in my opinion, to human existence. Disagreeing with that are major institutions like Johns Hopkins University. In your opinion, does consciousness cease to exist without a brain?

**Puthoff:** I am of the opinion that it does not cease to exist. If you need a substructure, or substratum, of course the vacuum energy gives you as much energy and activity as you need. There are a number of physicists who are exploring these new areas. I realize we don't have time to talk about that.

**Hieronimus:** Yeah, well maybe some other time we can, huh?

**Puthoff:** Alright!

**Hieronimus:** Would you join us again in the near future?

**Puthoff:** I would be glad to.

**Hieronimus:** Thank you.

**[End]**

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***Infinite Energy* subscriber, Thomas E. Phipps, Jr. of Urbana, Illinois shared with us his letter to Harvard University Professor and Physics Nobel Laureate Norman Ramsey, his former professor. This is the SECOND letter to Ramsey by an *Infinite Energy* subscriber (see letter by Dr. Scott Chubb, of the Naval Research Lab, *IE* #5&6, page 6).**

13 July 1996

Dear Norman,

I hope this finds you in good health, but will be surprised if it finds you at all, considering that the address I am using dates from 1987. I happened to subscribe to Mallove's *Infinite Energy* magazine and came across your name and picture in the latest issue. I know nothing about the physics of "cold fusion," but am fascinated by the morality play that is being played out under that rubric. Here is a technical development that might (with some small but non-vanishillg probability) hold the key to perpetuating our miserable species far beyond its deserts, getting it to the stars, etc. And here are specialists in the technical area in question lined up almost unanimously against giving a precious nickel of US money for exploring the possibilities. These specialists have nothing to lose but their personal reputations and literally everything to gain for their offspring in permitting a gamble to be taken with public money. So, will they permit it? Not on your tintype. Meanwhile, the Japanese are said to have upped their ante to $100 million/yr.

I am delighted that you are on the side of the angels in this matter, if the picture caption is correct in asserting that you "tried to resign from the [DOE Cold Fusion] Panel because of its unwarranted intended 100% negative conclusion." As I said at the start, I cannot judge the technical issue, but I do know (perhaps with the help of the training you gave me) how a scientist behaves and also how a bigot behaves . .. and these are not in general the same. I wish I could remember precisely the relevant quotation from Cromwell, I believe, which goes something like, "Gentlemen, I beseech you in the bowels of Christ [to recognize that] you could be mistaken."

Without knowing or caring, really, what the ultimate outcome of the cold fusion saga will be (surely its first effect, if the notion pans out, will be to enable the irresponsible reproductive behavior of our species to perpetuate itself unto truly disastrous levels), I am nevertheless ready to confer sainthood on Julian Schwinger for his exemplary courage in championing rationality on the scientific side of this matter. I enclose a copy of one of his talks aimed at physicists. Probably you have read it—but look at it again and imagine it spoken in his voice, as he always gave his lectures, with every comma in place. I defy you or any physicist to do this and to emerge devoid of some tolerance for the notion that the majority and their "consensus" could indeed be mistaken.

I have marked a section in his talk (the only one) that I find incoherent. He seems to me to contradict himself in the matter of causality vs. acausality of quantum action within a lattice. But later he seems to clear this up. It becomes clear that he is neither a radical nor a heretic, but is only preaching to the quantum theorists a tiny extension of what they claim already to know. I, by contrast, happen to believe that the trouble goes deeper, and that actions upon "the lattice as a whole" cannot take place *in principle* or in thought, while the "relativity of (distant) simultaneity" stands.

With best wishes,
Thomas E. Phipps, Jr.

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## Key Paper in Mainstream Physics Journal Allows Energy from Space!

The following is the abstract from what may be one of the most important papers for the New Energy field:

*Physical Review Letters*; 13 May 1996
Volume 76, Number 20, pp.3842-3845

### Sonoluminescence as Quantum Vacuum Radiation

**Claudia Eberlein**
*Department of Physics University of Illinois at Urbana-Champaign. Urbana, Illinois 61801-3080*

(Received 2 June 1995; revised manuscript received 11 December 1995)

Sonoluminescence is explained in terms of quantum vacuum radiation by moving interfaces between media of different polarizability. It can be considered as a dynamic Casimir effect, in the sense that it is a consequence of the imbalance of the zero-point fluctuations of the electromagnetic field during the noninertial motion of a boundary. The transition amplitude from the vacuum into a two-photon state is calculated in a Hamiltonian formalism and turns out to be governed by the transition matrix element of the radiation pressure. Expressions for the spectral density and the total radiated energy are given.

**Editor's Comment:**

What are the implications of this seminal Eberlein paper? Nothing less than that a well-recognized, yet deeply mysterious phenomenon, sonoluminescence, *might* be explained by the extraction of energy from the vacuum of space. Looked at another way, *without* that explanation it may be that the light pulses of sonoluminescence would have no explanation, and would even *appear* to violate conservation of energy—just like over-unity New Energy processes.

That a mainstream physics journal would print the suggestion that a water system could be tapping zero point energy could have far reaching consequences. Here we have a model for processes that could well be occuring in "cold fusion" experiments, in fluid cavitation systems such as the Griggs Hydrosonic Pump™, and perhaps even in the apparent low energy transmutation phenomena that are so rampant now in the cold fusion field.

The Eberlein paper outlines why various conventional theories cannot acount for sonoluminescence. She acknowledges that Nobel Laureate Julian Schwinger was first to suggest that sonoluminescence might originate in the Casimir effect, "in the sense that zero-point fluctuations might lie at the origin of the observed radiation." Eberlein notes, "Sonoluminescence might be the first identifiable manifestation of quantum vacuum radiation."

Eberlein writes: "The surface of an air bubble in water is such an interface between two dielectric media. When the bubble collapses, the motion of the interface is highly non-linear; the acceleration and higher derivatives of the velocity attain values that are high enough to make quantum vacuum radiation a non-negligible process."

Eberlein states that the characteristics of SL fit her theory very well: "In conclusion, it can be said that at this crude level of inspection the theory of vacuum radiation seems to agree remarkably well with the experimental results on sonoluminescence. The amount of the radiation and the thermal-like spectrum are returned by the theory and further numerical investigations will uncover more details. Likewise, one has no difficulty explaining the shortness of the observed pulses. The pulse length is dictated by the time it takes for the zero-point fluctuations to correlate around the bubble and by the turnaround time of the velocity about the collapse; both are much shorter than 10 ps. Another major point that is clarified by this theory is that there are practically no photons created in the UV and at even higher energies as water has no appreciable polarizability there. Hence no radiation has to be absorbed by the surrounding water."

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## THE SECOND INTERNATIONAL LOW ENERGY NUCLEAR REACTIONS CONFERENCE (Preliminary Program)

Holiday Inn, College Station, Texas

Joint Chairmen:
Prof. John O'M. Bockris
(Texas A&M University)
Prof. George Miley
(University of Illinois)

**September 13, 1996**

**Introduction**
8:30 - 8:35 Professor J. O'M. Bockris

**Basic Experimental Studies (I):**
Chairman: J. O'M. Bockris

8:35 - 9:05 Professor G. Miley (University of Illinois): "Nuclear Reactions in Palladium-Hydrogen System"

9:05 - 9:35 Dr. T. Mizuno (Hokkaido University): "The Reaction Products Induced by Isotopic Changes of Electrolysis"

9:35-10:05 Professor J. Dash (Portland State University): "Excess Heat and Unexpected Elements from Electrolysis of Acidified Heavy Water with Titanium Cathodes"

*Coffee Break (10:05 -10:20)*

**Basic Experimental Studies (II):**
Chairman: G. H. Lin

10:20 - 10:45 Dr. Stanley Szpak (COSC, Navy): "Nuclear and Thermal Events Associated with Pd + D Co-deposition"

10:45- 11:10 Dr. Z. Minevski (Lynntech): "New Elements Formed in the Electrolysis of Light Water on Palladium"

11:10- 11:35 Dr. Mitchell Swartz (JET Technology): "Deuterium Production and Light Water Excess Enthalpy Experiments Using Nickel Cathodes"

11:35 - 12:00 Russ George (E-Quest Sciences): "Isotopic Ratio Anomalies Induced in Palladium by the Application of Intense Ultrasound"

12:00 - 12:25 Dr. Robert Bass: "Low-Energy Nuclear Reactions in an Electrolytic Cell"

Luncheon Break (12:25 -1:40)
*A photo will be taken at 1:25 in the front of the Holliday Inn*

**Basic Experimental Studies (III):**
Chairman: G. Miley

1:40 - 2:10 Professor R. Bush (Calif. State Polytech. Univ.): "Nuclear Reactions in the Pd and Ni System."

2:10 - 2:40 Dr. R. Notoya (Hokkaido University): "Evidence of Nuclear Reactions found by Measurement of Radioactivity in Electrolytic Cells"

2:40 - 3:10 Dr. Thomas Claytor (Los Alamos National Laboratory): "Tritium Production From Palladium and Palladium Alloys"

3:10 - 3:40 Dr. T. Ohmori (University of Hokkaido): "Isotopic Distributions of Heavy Metal Elements Produced During the Light Water Electrolysis on Au Electrode"

*Coffee Break (3:40 - 3:55)*

**Theoretical Models:**
Chairman Guang H. Lin

3.55 - 4.25 Professor Y. E. Kim (Purdue University): "Nuclear Physics Mechanisms for Gamow Factor Cancellation in Low-Energy Nuclear Reactions"

4:25 - 4:55 Dr. Y. Kucherov (ENECO): "Lattice-Phonon Resonance and Energy Transfer at a Nuclear Level"

4:55 - 5:25 Dr. Albert Cau (Paris ): "Natural Nuclear Synthesis of Superheavy Elements"

5:25 - 5:55 Dr. Hal Fox (Fusion Information Center): "Possible Palladium-Related Nuclear Reactions"

*Dinner (7:00 - 9:30)*

**September 14, 1996**

**Innovative Approaches:**
Chairman: J. O'M. Bockris

8:30 - 8:50 Dr. Guang H. Lin (Texas A&M University): "Anomalous Radioactivity and Unexpected Elements as a Result of Heating Oxide Mixtures"

8:50 - 9:10 Mr. Toby Grotz (Wireless Engineering): "Synthesis of Iron via Arc Discharge through Activated Carbon"

9:10 - 9:30 Dr. Ken R. Shoulders: "Observations on the Role of Charge Clusters in Nuclear Cluster Reactions"

9:30 - 9:50 Mr. E. Bauer & Dr. R. Monti (Burns Development Ltd.): "Variations of the Half-Lives of Radioactive Elements and Associated Cold Fusion and Cold Fission Reactions"

9:50-10:10 Dr. Andrew Michrowski (Planetary Clean Energy Association): "Advanced Transmutation Processes"

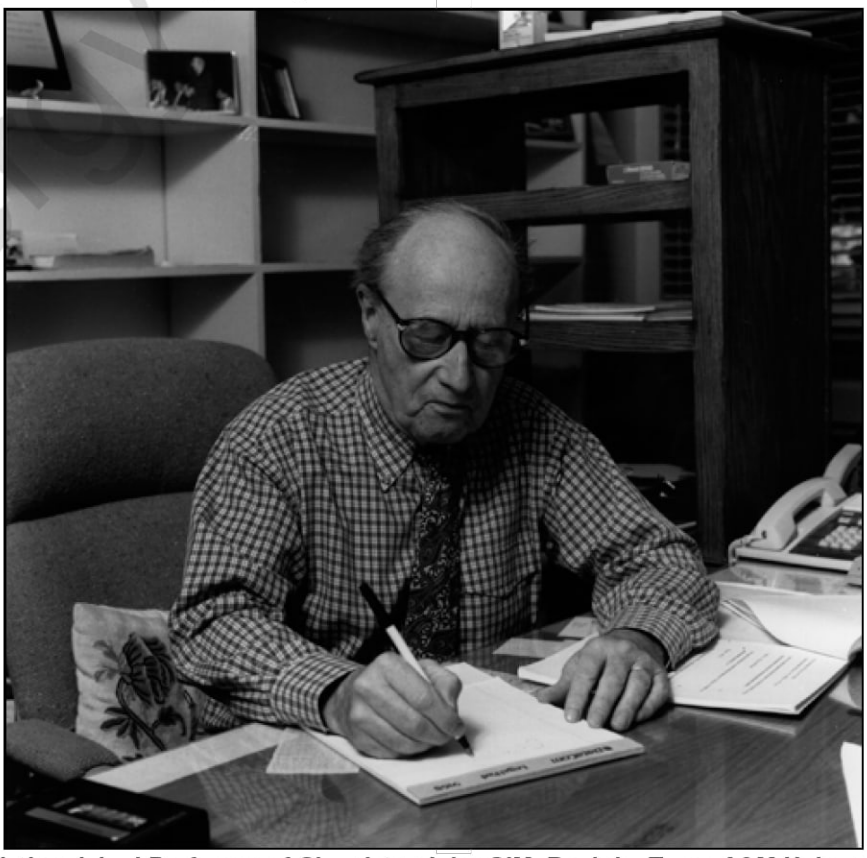
*Coffee Break (10:10 - 10:30)*

**Discussion:**
Chairman: G. Miley

10:30- 12:00 Open Discussion

12:00 - 12:05 Dr. G. Miley: Conclusion

**Editor's Note:** This meeting is limited and open to serious researchers only—mostly those with results to show. Contact the office of Dr. G. Lin for further details: Phone: 409-845-3661; Fax: 409-845-4205



**Distinguished Professor of Chemistry John O'M. Bockris, Texas A&M University**

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# MEDIA WATCH

**Chris Tinsley, Nottingham, U.K.**

Rightly or wrongly, we don't take inaccurate media reports on cold fusion very seriously these days. For one thing, we know that public acceptance of the phenomenon will not come about through our correcting false reports there. For another, letters correcting those reports just get shelved, usually without any acknowledgement. An example was a recent small piece by Barry Fox in the important London broadsheet *The Daily Telegraph*. He managed to get more errors into a few column inches than I would have thought possible, as can be judged from my reply:

Sir,

I saw with interest Barry Fox's 'TechnoTurkey' article, "Cold fusion cools off," (July 30, 1996). Might I point out some errors in this account?

Professor Martin Fleischmann is not an American, he is a British electrochemist, and a Fellow of the Royal Society.

"Once started, the reaction would produce more electricity than it consumed. So the water cell would become a super-efficient battery, delivering free electricity without heat." In fact, a 'cold fusion' cell produces no electricity at all, only heat. It would be quite useless as a battery.

"Japanese optical company Canon set its researchers on the task; Matsushita and Panasonic started research and filed worldwide patents." Indeed they did, but these were comparatively minor players. More significant are Hitachi, Toyota, Mitsubishi Heavy Engineering and the bulk of the Japanese universities, under the general umbrella of the 'New Hydrogen Energy' program of the Ministry of International Trade and Industry, which has recently increased its 'CF' investment from $25m to $100m. When MITI began its sponsorship of 'CF' in 1992, it was with ten major industrial companies; that number has now grown to twenty. Outside Japan, much excellent work is in progress in the USA, and in Europe 'cold fusion' research is sponsored by Shell France and Fiat.

"Matsushita mass-produces batteries and was clearly hedging bets." I would suggest otherwise, since the only similarity between a 'cold fusion'-cell and a battery is that they both use electrochemical techniques.

"Its researchers pushed 20 volts through heavy water ..." Voltage 'pushes' electrical current; volts cannot be pushed. "...and saw a lot of bubbles..." Of course they did, that was the electrolysis of the heavy water into deuterium and oxygen. "...and concluded that 'a nuclear reaction was caused at room temperature'." Not from the bubbles, they didn't!

"But seven years on, cold fusion is forgotten."

This is very far from the truth. I append a list of recent results from this ever-growing field. With your interest in new technology, you might consider covering the Sixth International Conference on Cold Fusion (ICCF6), sponsored by MITI's New Energy Technology Development Organization (NEDO) in October.

Yours faithfully,

Naturally, I received no response from Mr Fox.

*New Scientist* still takes a negativist line, but I sense that they (and others in the UK) are beginning to hedge their bets. In their May 25, 1996 issue, I saw a comment in the "Washington Watch" column, saying that CF is "the scientific embarrassment that won't go away." The article tells us, "Disregarding the scorn of the international physics community, they insist that their experiments still produce more heat than any chemical reaction could explain. Recently, several scientists at the renowned Naval Research Laboratory in Washington DC became intrigued by the experiments. They invited a few of the cold fusion researchers to present their work at the NRL. But, hearing of the meeting, higher-ranking officials at the laboratory sensed a PR fiasco in the making. They decided that cold fusion was still too hot to handle and banned media interviews with NRL scientists on the subject. The cold fusion meeting went on as scheduled, but inquiring reporters were informed that scientists at the NRL 'had nothing to say' on the topic."

Quite.

Cold fusion usually gets a better press in France, and in *Sciences et Avenir* for July 1996, there is an article on the Patterson cell. Here are a few quotes, with apology for clumsiness in my translation:

"The significance of the phenomenon is the stuff of dreams: the heat obtained is a thousand times greater than the energy input. Researchers at CETI (Clean Energy Technology Inc), the private laboratory behind the experiment, are categoric: fusion is produced at room temperature.

"Already in April 1995, George Miley of the University of Illinois and CETI researcher [sic!] has demonstrated cold fusion, less spectacularly: 2.5 watts of energy obtained from 0.14 watts input. In October, at the 16th SOFE meeting (Symposium On Fusion Engineering), he announced that he had improved his results, with 0.06 watts input and 5 output.

"But the demonstration at the Power Gen conference at Anaheim in California by CETI has provoked a veritable earthquake among attendees. They had seen an almost inexhaustible source of 'clean' energy. Others, more skeptical, suspect a clever trick.

"It is a long time since anybody tried to sell me Brooklyn Bridge," joked Howard Birnbaum, research director in materials science at Illinois University [and former 1989 DOE ERAB Cold Fusion panel member—*Ed.*] . "Nothing explains how they get more energy out than is input."

Of course, this last paragraph sums up the position of the "aware skeptic." Nothing can be done about the results of CF, so two objections are now offered — fraud and the lack of an accepted explanation. This magnificent international scam is orchestrated by of course the Masons, the UN, the Black Government of the United States and the Illuminati — taking turns perhaps. And of course these con-men just can't provide a mechanism to explain their results, which means those results can be safely ignored — and we can start ignoring all the other unsolved problems of science. If the theorists propose a mechanism, that can be safely ignored too, because it would disagree with current theory. Yossarian, anti-hero of the magnificent *Catch 22*, would know the feeling.

Yet this illogic still holds sway. We see it again in *Chemical & Engineering News*, which in its April 29 issue editorializes: "From the sublime to the ridiculous, I read with considerable amusement Senior Editor Ron Dagani's Science Insights, 'Cold fusion lives--sort of' (see p.69).' Turning to that page, we see quoted (of all people) myself; saying that commercialization is the only way forward. Dagani says he isn't sure that this logic makes much sense, but accepts that if CETI succeed in selling then it might. What he fails to appreciate is that in a world gone barking mad one must adopt the logic of the lunatic asylum.

One thing we can be sure of is that few scientists will ever see their derision in its social context. It just does not (and will never) occur to them that their attitude has helped so many to an early death from pol-

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lution diseases, or that they will bear partial responsibility for those deaths. As I write this, England is suffering what is for us a heat-wave, of ninety degrees and more; the BBC's Newsnight current affairs program is discussing the resultant air pollution and what little can be done about it. Apparently Volvo Bus and Truck are spending half their research money on trying to do something about this — so perhaps I should send them a few copies of *Infinite Energy*. Certainly the hot fusion program seems not to be seen as a prospective savior for industrial man, with his streaming eyes and struggling lungs. The funding cuts (*New York Times*, April 23, among many other commentators) reflect this feeling — and not before time.

Throughout the media, more and more, we see a growing acceptance of the greenhouse effect and the need to cut our use of fossil fuels. I have not followed the science arguments on all this, so I can't offer an opinion. An article in *The Wall Street Journal* (last December 26) seems to indicate that the US, as the major contributor of "greenhouse gases," is reluctant to accept the problem as real, while other nations see it as more serious.

But we should not worry too much about the opposition, we should be more aware of the problems with "our own side." The opposition can never stop CF but, unless the CF community gets wise, they will never need to. *Science* (April 26) reports on the failure of Fleischmann and Pons in their libel case against the Italian newspaper *La Repubblica*, saying that the "court of scientific opinion passed judgement on cold fusion years ago." I was sufficiently moved that I wrote:

*I've just heard the result of a court case in Italy, the one where Fleischmann and Pons and others sued the* Repubblica *newspaper for referring to cold fusion as scientific fraud and themselves as being like ' fornicating priests'. They lost the case. This has been gleefully reported on sci.physics.fusion by the scientific advisor to the defense, one Dr. Douglas O. Morrison of CERN — of whom my opinion is about as low as my opinion sinks.*

*So, why am I pleased? Because I hope this will finally knock some sense into the heads of CF people. I said in Boston (January 20, 1996) that we haven't got time for science in CF. That was not because I'm against science — I'm all for it — but because (as I also said) scientists will believe anything which they are funded to believe. Also, contrariwise. But there's only one way they'll be funded.*

*"If the CF wars are to be fought within science, then Planck's Other Constant will apply. Planck set this value at 20 years, the time it takes for fresh minds to overcome the past.*

*Look at those old films of the nuclear physicists of the 1930s and 1940s. Notice the 'buzz' they all radiate? Compare them with today's crop. Scientists they may be, but primarily they are the guardians of Holy Writ.*

*So, how do we reduce Planck's twenty years? By putting the machines into the hands of people with money, showing that they work, and bringing some materials scientists in on the act - in a big way. Not piecemeal, and most definitely not by doing "[eally good science" to find out exactly why they work. We need that right now like we need a hole in the head.*

*I will bet that some of the big companies who are now dabbling in the field are finding that the problems of reproducibility of results will not have gone away. I will also bet that some of them are cutting their losses and getting out of CF. The solutions to non-reproducibility are likely to be counter - intuitive. A single corporation essentially means a single individual controlling its research. If that individual has a fixed idea, then —if it is a wrong idea — no hope there.*

*Meanwhile, out there we have all these little groups. Some want the Nobel, others are like Tom in Tom & Jerry, with $$ signs in their eyeballs. All of them seem to think that they have the one best system, and are terrified that if they tell anybody about it then somebody will find an improvement or circumvent their patents.*

*Commercial secrecy is legitimate, but paranoia, irrational greed, and secretiveness are not. I would suggest to these groups that they are far more likely to be relegated to the most microscopic of footnotes. Other people with a more open, cooperative and positive attitude will just walk past them.*

*And let us be clear about the present role of science in CF. Its role is primarily to help in the development of high-performance machines, and to ensure the safety of products.*

*Once there are products - even poor-quality, low performance products —then there will be no shortage of scientists to work on improving them. There will also be plenty of funding to find out the basic phenomenon. In the face of such funding, there will be plenty of believing scientists.*

*To find the mechanism —or mechanisms — of CF is perhaps the most important aspect of the subject, but it is certainly the least urgent.*

*Maybe this court judgement will wonderfully concentrate a few minds. I doubt it, though. As Schiller puts it:*

*"Mit der Dummheit kämpfen Götter selbst vergebens."*

*Right, is that. And if the gods themselves contend in vain against stupidity, I don't give much for the chances of an Italian judge.*

I wasn't very popular in the 'cold fusion'-community for writing that. Jed Rothwell isn't very popular for his "inventor's disease" ideas either. And it should be made clear that there are many marvelous people in the field. Our respect for Fleischmann and Pons and the rest is not diminished just because we think they are too secretive.

Moving to more positive topics I find myself attracted to the whole idea of the Stochastic Electrodynamics, so well summarized in Dr. Haisch's article in issue #5&6. Various aspects of this subject have been touched on in various media recently and, although not all of them are energy-related, a browse through the latest news is quite interesting. Again in *New Scientist* (June 8, 1996), there is a report by Paul Guinnessy on a new paper by Sipko Boersma, an independent physics consultant based in Delft. In this paper (*American Journal of Physics*, vol. 64, p. 539) Boersma succeeds in explaining why an 1836 French sailing manual, The Mariner's Album, was right to warn sailors that ships lying side by side must be protected from colliding with one another. He shows that the "Casimir effect," which demonstrated that plates in close proximity are pushed together by the zero-point fluctuations, works just as well with waves on the sea. So an idea from quantum physics is shown to work just as well with classical physics — treating the ZPF as electromagnetic waves.

This may all seem a bit esoteric, but it leads into something which may be closer to our hearts. It seems that the Hydrosonic 'pump' (the 'Griggs machine') produces its excess energy from cavitation. It is no big leap to suggest that this may in some way tie in with sonoluminescence, which is presently quite a hot media topic. Some see the collapsing micro-bubbles of sonoluminescence as producing incredible temperatures and pressures: *New Scientist* last year talked about two million degrees. Not enough to induce plasma-fusion, surely, (and no radiation has been seen) but perhaps enough to induce some unsuspected physical process. A young researcher (Claudia Eberlein, of Cambridge University) has written a paper (*Phys Rev Lett.* 76, 3842, 1996) in which she suggests that the sudden pulses of light from a sonoluminescence bubble may be from the ZPF. These pulses are so short (50 picoseconds) that they last only as long as the time light takes to travel three fifths of an inch. The

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idea is that the collapsing bubble's surface is accelerating, and an unbalanced radiation is produced from the ZPF in the way that Stephen Hawking has predicted will occur at the boundary of a black hole.

Eberlein's paper was commented on all over the place, notably in *The Economist* (June 6, p110), Nature (381:736-7, June 27), and even so far afield as the *Houston Chronicle* — which feels obliged to tell its readers that Cambridge University is in England. She believes that energy is conserved in this process, but Julian Schwinger thought (and Hal Puthoff thinks) that it may not be. If it is not, then we may already have an explanation for the Griggs machine and perhaps a lead on other energy-producing CF experiments.

The subject of the zero-point fluctuations came up again in a recent television science series. This is *Future Fantastic*, a truly awful effort which is a joint production by the BBC and The Learning Channel. It is one long gimmicky sequence of soundbites and disjointed images, hosted (badly) by Gillian Anderson. I don't know if it has yet been shown elsewhere. One of the programs was more interesting, since it covered not only the Griggs device, but various 'free energy' ideas — together with antigravity and the like. Robert Forward was shown discussing using the ZPF as an energy source and Professor Frank Close, that one-time scourge of the unconventional in science, seemed quite positive about it all.

Although I haven't actually read the book, I've seen some supporting articles and reviews of John Horgan's *The End of Science*. Apparently, science has solved all the basic questions and we can all go home now. Worse, in some fine revisionism, Horgan argues that not only is science right to believe that all is virtually complete, but that it is a myth that science ever believed that before. In other words, not only is science right in the present — but it was never wrong in the past. After the book was reviewed in *The New York Times* (June 30), one Matthew Kartch had a letter printed there (July 4) showing just how wrong Horgan was about that.

From 14th edition of Bartlett's Familiar Quotations but omitted from the 15th and 16th editions:

*From Nobel Laureate Michelson's address at the dedication ceremony for the Ryerson Physical Laboratory at the University of Chicago in 1894:*

*"The more important fundamental laws and facts of physical science have all been discovered, and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote.... Our future discoveries must be looked for in the sixth place of decimals."*

As Mr. Kartch so eloquently puts it, "Been there. Heard That."

**Experimenter's Corner.....**

## Semiconductor Temperature Sensors: *An Elegant solution*

**by Bruce Vicknair**

Research into the thermodynamics of cavitating systems requires high resolution thermometry. The venerable thermocouple and RTD are problematic, requiring precision amplifiers, cold junction compensation, and linearization respectfully. I basically wanted a high-level, linear, user-friendly, noise-free device requiring no active support parts. It had to cost practically nothing and be easy to procure. Having some samples of the Analog Devices AD290, I tested them with a direct connection into a Linear Technology LTC1294 8-channel 12-bit A/D converter. Even with playing tricks on the current load resistor and reducing the A/D reference voltage, I still could not get sufficient resolution. I then looked at the National Semiconductor LM35 sensor. This device outputs *10 millivolts per degree Centigrade*. Bulk fluid temperatures of interest in defect collapse research are 10° to 65 °C [1] The TO-46 metal case can operate at 125 °C so we are well within its operating range. Maximum full-scale output voltage would then be 1.25v. The LTC1294 was designed to work with a 1.25v reference allowing 4096 discrete data points with a resolution of 0.0305°C. The Motorola MC68HC11 microcontroller (Fig. 1) provides an offset in real-time based on calibration data stored in EEPROM. I use boiling water as a reference. Corrected values and elapsed time are output via RS232 in ASCII spreadsheet form once a second. Software is written in ANSI 'C' and assembly language. There are no hardware adjustments. The temperature sensing node (Fig. 2) utilizes bypass capacitors to keep the LM35 stable at cables length. On the receiving end a single capacitor/resistor provide low pass filtering. The TO-46 package can be brushed with sandpaper and soldered to a copper clamp or band; however, I recommend DC isolation using a ceramic adhesive or thermally conductive insulating pad to prevent ground loops.

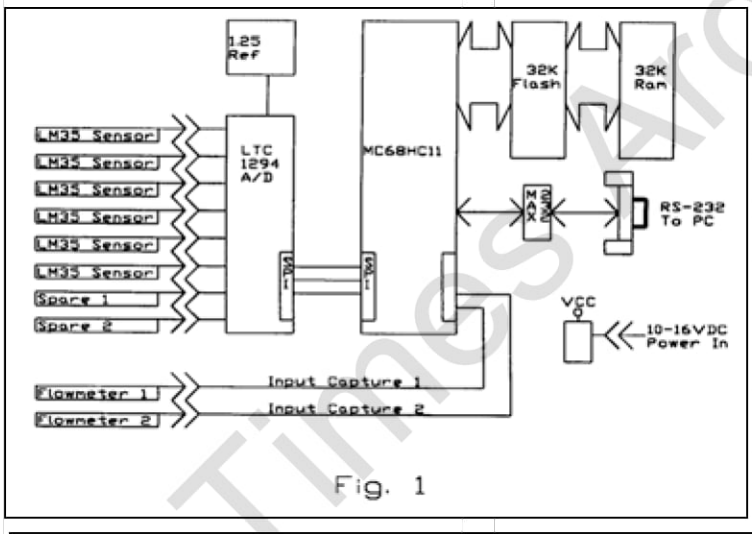

Fig. 1

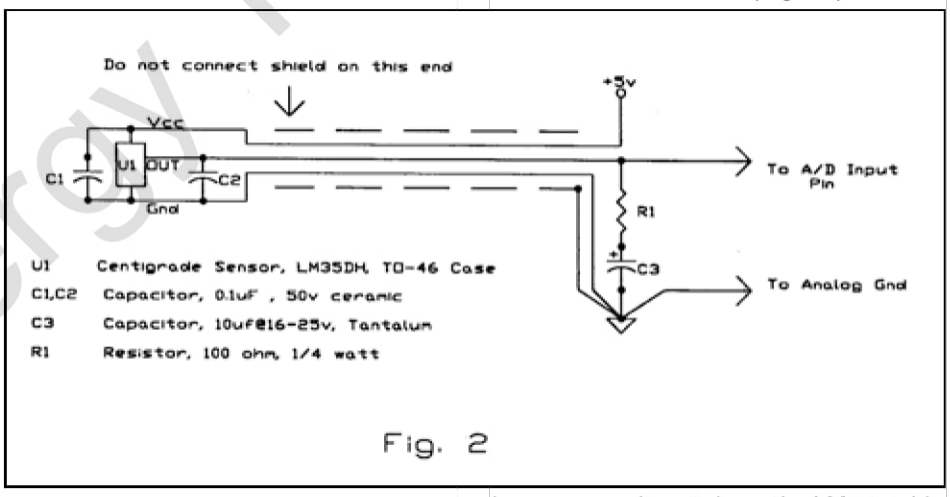

Fig. 2

1. F.G. Hammitt, "Collapsing Bubble Damage To Solids," *Cavitation State of Knowledge*, ASME Fluid Engineering Conference, pp. 87-102, 1969.

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# A STUDY OF THOSE PROPERTIES OF PALLADIUM THAT INFLUENCE EXCESS ENERGY PRODUCTION BY THE "PONS-FLEISCHMANN" EFFECT

**Dr. Edmund Storms**
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**Santa Fe, NM 87501**

**ABSTRACT**

A large collection of palladium plates having different treatments were examined to determine the composition limit produced after electrolysis in LiOD-$D_2O$ electrolyte, the amount of excess volume produced by the contained deuterium, the open circuit voltage generated by the material referenced to a platinum electrode, and the deloading rate in air. The influence of these properties on the ability to produce excess power from the "Pons-Fleischmann" effect was explored.

The palladium was found to be very nonuniform with respect to the measured properties. Excess power production was associated with a minimum amount of excess volume and an open circuit voltage above 1.0 V. Samples capable of producing excess energy can be reactivated even after deloading or removal of the surface.

**INTRODUCTION**

Reproducibility has been a major problem for the acceptance and study of the "Cold Fusion" effect. This problem is now recognized to be caused by the difficulty in achieving the required physical and chemical environment [1]. Past work has relied mainly on chance to provide useful palladium. Unfortunately, experience has shown that commercial palladium has a low probability for having the required properties. In addition, there is reason to believe that only rare, isolated regions on the palladium surface become active. These regions are formed where a variety of chemical and physical properties combine to create the necessary local condition. The nature of these properties is still poorly understood, hence difficult to create. Therefore, it is important to develop an easy method to identify useful palladium and to discover which properties need to be enhanced by the manufacturing process.

Past work [2;3;4;5;6] demonstrates that the deuterium content is one of these important properties. Excess energy production is not achieved unless the average composition is above a critical value. Therefore, this behavior needs to be a major part of any pretest method. The other measurements used in this study are related to the properties that influence the achieved composition.

The deuterium content depends on a competition between gain and loss. Gain is determined, in part, by the ease with which deuterium ions can enter a particular surface region from the solution. Gain from all of the regions combine to produce the measured, overall gain. Loss depends, in part, on the number of cracks that penetrate the surface. These defects provide an easy avenue for escape of deuterium as $D_2$ gas. Because both of these properties are randomly distributed, their optimal interaction is expected to be rare and random. Only a small number of regions will allow easy gain of deuterium while being sufficiently removed from a surface crack to retain the required very high composition.

Although the detailed surface properties are not easy to measure, the average gross properties can be determined. Presumably, a sample that readily absorbs deuterium and has a smaller number of cracks would achieve the critical composition at a greater number of surface sites, hence produce a larger amount of excess power. Although many of these cracks will not penetrate the surface, consequently not provide an escape path, the presence of fewer cracks should, nevertheless, be of benefit. Unfortunately, the number of cracks cannot be directly determined. Instead, the gross volume associated with these cracks is measured and used to monitor changes in the gross crack concentration. A previous study found that excess energy production was influenced by the excess volume concentration.[4] This study extends the discovery.

When the applied voltage is turned off, deuterium immediately begins to leave the palladium as $D_2$ gas. The loss rate may be used a guide in judging the nature of the surface barrier to both deuterium loss and gain while the sample is being electrolyzed. It is proposed that this loss rate continues largely unchanged even while electrolysis is adding deuterium to the sample.

A potential is generated between the cathode and a reference electrode when the electrolyzing current is briefly interrupted. This potential is produced by chemical reactions occurring within the surface of the cathode. Pure β-PdH produces 40-50 mV referenced to pure Pd, a value that is consistent with the Gibbs energy of formation of the phase. Much higher potentials are generated in "cold fusion" cells because, it is believed, lithium and other impurities form alloys in which hydrogen is much more stable than in β-PdD. Even though the potential is influenced by the presence of these impurities, a change in the voltage is expected to be proportional to a change in the deuterium content of the surface. In addition, this alloy structure is apparently required for the energy producing reaction to occur. Therefore, the open circuit voltage (OCV) provides a means to reveal the presence of the required conditions.

The first part of this study examines eighty pieces of palladium supplied by IMRA Materials R & D Company (Japan) to determine the limiting composition, the excess volume, the deloading rate in air, and the open circuit voltage. Information about the relationship between these properties and their reproducibility between samples is sought. The second part of the study explores the relationship between these properties and the production of excess power. The latter study is still ongoing. No attempt was made to detect nuclear products.

## Part I
## Material Properties

**EXPERIMENTAL**

The supplied palladium samples (20 mm x 10 mm x 1 mm) were cut from a 10 mm wide strip of palladium. The numbering is sequential. All samples were polished using 0.5 $\mu$m diamond slurry. Some

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TABLE 1

As Delivered Properties of the Palladium Samples

| Designation | Surface | Vickers Hardness | Grain Structure | Lattice Parameter, Å |
|---|---|---|---|---|
| A1-B1 | Pd>S=C>O | 115 | Uneven fiber | 3.8954 |
| A1-B2 | O>Pd | 58 | Irregular grain size | 3.8896 |
| A1-B3 | O>>Si>Pd | 60 | Irregular grain size | |
| A2-B1 | Pd>C>O>S | 219 | Uneven fiber | 3.8991 |
| A2-B2 | O>PD>C | 109 | ≈200 μm grains | 3.8916 |
| A2-B3 | O>>SI=Pd | 109 | ≈200 μm grains | |

Palladium powder contained the following in ppm: 20 Pt, 17 Au, 52 Ag, 6 Ca, <10 Cr, 8 Cu, 10 Fe, 1 Mg, <1 Si. The following were sought but not detected: Rh, Ir, Ru, Os, Al, As, Bi, Cd, Co, Mn, Ni, Pb, Sb, Sn, Ti, Zn, W, Zr and Mo.

TABLE 2

Pretreatment of Samples

BASIC PROCESS

Arc melted
Cast in vacuum
Annealed in vacuum at 750° for 1 hr
Swaged to 8 mm diameter
Rolled to strip >10 mm wide and 1.2 mm thick
Cut samples to 10 mm wide and 20 mm long
Polished using 0.5μm diamond slurry.

ADDITIONAL TREATMENT

A1-B1, pure palladium + basic process
A1-B2, pure palladium + basic process+ annealed in air at 750° for 24 h.
A1-B3, pure palladium + basic process+ annealed in vacuum at 750° for 24 h.
A1-B4, pure palladium + basic process+ annealed in vacuum at 750° for 24 h, etched with Aqua Regia for 10 min, annealed in vacuum at 200° for 24 h.

A2-B1, (palladium + 500 ppm boron) + basic process
A2-B2, (palladium + 500 ppm boron) + basic process+ annealed in air at 750° for 24 h.
A2-B3, (palladium + 500 ppm boron) + basic process+ annealed in vacuum at 750° for 24 h.
A2-B4, (palladium + 500 ppm boron) + basic process annealed in vacuum at 750° for 24 h, etched with Aqua Regia for 10 min, annealed in vacuum at 200° for 24 h.

were given additional treatments. Information supplied by IMRA is listed in Table 1.

The samples can be divided into 8 sets based on their pretreatment and chemical composition as shown in Table 2. Each piece was subjected to several measurements before, during, and after pretreatment by electrolysis using a 0.3N LiOD + $D_2O$ electrolyte and a platinum anode. Selected samples were then studied in a calorimeter.

A. Initial Limiting Deuterium Content:

Electrolysis causes a rapid initial increase in the deuterium content followed by a more gradual approach to a nearly constant value. An example of this behavior is shown in Fig. 1. The constant value is taken as the composition limit. Further electrolysis can cause the deuterium content to gradually increase over many days. This process results in a somewhat larger final value which is not addressed here. The samples were weighted before and after electrolysis to an accuracy of ±0.0001 g. The increased weight was assumed to result from the uptake of deuterium. Values are estimated to have an uncertainty of ±0.002 in the atom ratio. For a few samples, deuterium uptake was monitored during electrolysis by determining the amount of oxygen that accumulated within the closed cell.

B. Excess Volume:

Palladium expands as it reacts with hydrogen or deuterium. When the average composition exceeds the lower limit of β-PdD, stress produced by additional hydrogen causes a volume expansion beyond that expected from the lattice parameter increase. This effect can be seen in Fig. 2.[8] Much of the expansion is retained when the hydrogen is removed. Most samples show an additional excess volume increase each time the loading process is repeated. This excess volume is presumed to be caused by cracks and dislocations within the material.

The dimensions of each piece were measured before and after electrolysis using calipers. The first measurements were made using calipers having a sensitivity of 10 μm while later work used a micrometer having a sensitivity of 1 μm. Measurements were made at 3 positions along each dimension and these were averaged to give the total volume. The uncertainty in the reported percentage is estimated to be ±0.5% for the early measurements and ±0.2% for later studies.

After being electrolyzed, the palladium was again measured. Excess volume fraction was calculated using the following equation.

EV = [(Final Volume)-(Initial Volume)] / (Initial Volume) - (0.0172+0.14125*D/Pd)

This equation applies only to samples having a composition within the β-PdD phase. Because the actual EV is sensitive to the D/Pd ratio, all comparisons were made by extrapolating the value to a fixed composition of D/Pd=0.85.

C. Open Circuit Voltage:

Measurement of the voltage developed between the cathode and a platinum reference electrode is made after the applied voltage is interrupted for a brief time. Flame heating the platinum in air allows for a stable, although not an absolute, voltage. A Luggin capillary is used in most cases. This method allows a small region of the cathode to be examined. Some cells also contain an immersed platinum mesh from which an average voltage is obtained. The voltage is always referenced to the voltage generated between the Pt reference electrode and the palladium cathode before loading starts. This voltage is generally 0.04 ±0.02 V. Measurements are made as a function of average D/Pd atom ratio during the loading and deloading of a few samples.

D. Deloading Rate:

Once the charging current is stopped, deuterium loss commences. The sample is removed from the cell and weighed at regular intervals. The resulting D/Pd ratio is plotted as a function of square root of time and a least squares line is fit to the data.

The slope of this line is used to compare the deloading rates and to extrapolate the D/Pd ratio back to the time the current was stopped.

## RESULTS

### Composition Limit

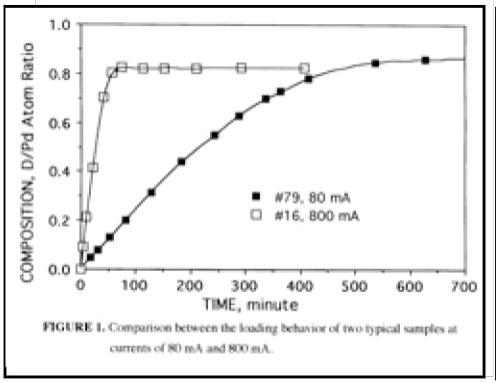


FIGURE 1. Comparison between the loading behavior of two typical samples at currents of 80 mA and 800 mA.

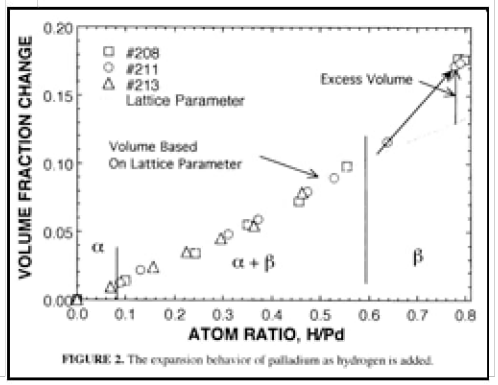


FIGURE 2. The expansion behavior of palladium as hydrogen is added.

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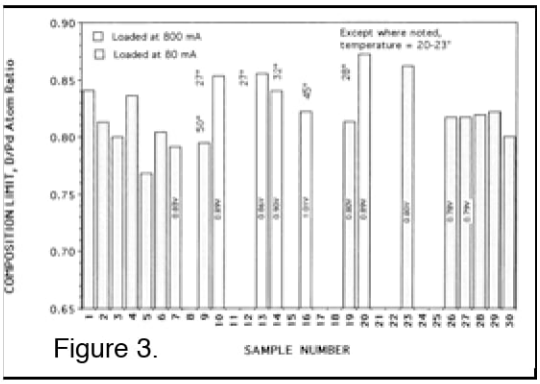


Figure 3.

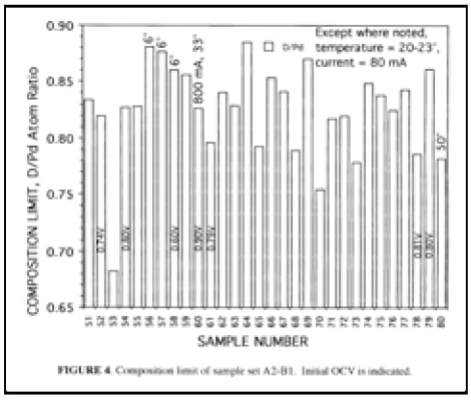


**FIGURE 4.** Composition limit of sample set A2-B1. Initial OCV is indicated.

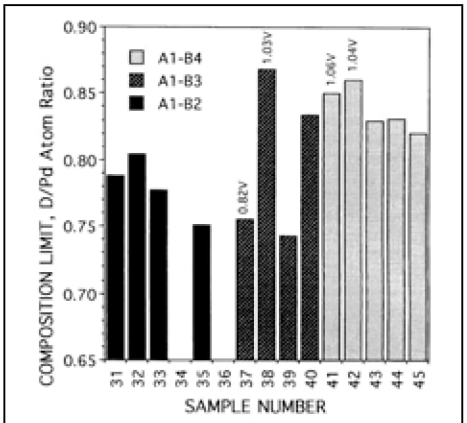


**FIGURE 5.** Composition limit of sample sets A1-B2, A1-B3, and A1-B4. Initial OCV is indicated.

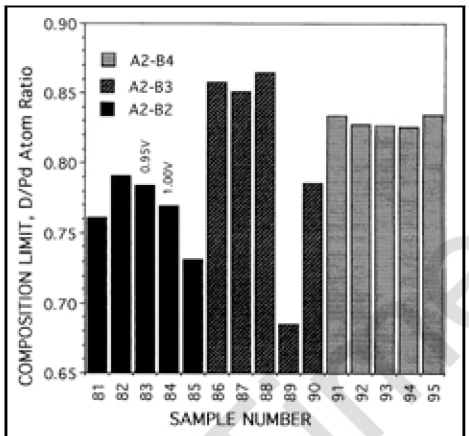


**FIGURE 6.** Composition limit for sample sets A2-B2, A2-B3 and A2-B4. Initial OCV is indicated.

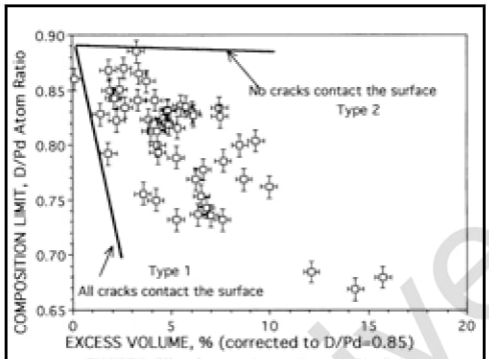


**FIGURE 7.** Effect of excess volume on the composition limit.

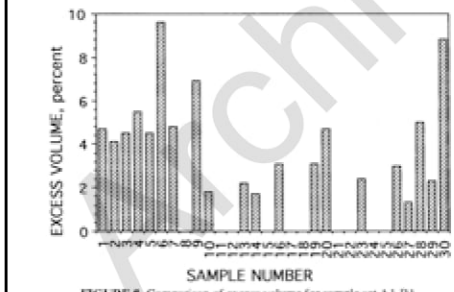


**FIGURE 8.** Comparison of excess volume for sample set A1-B1.

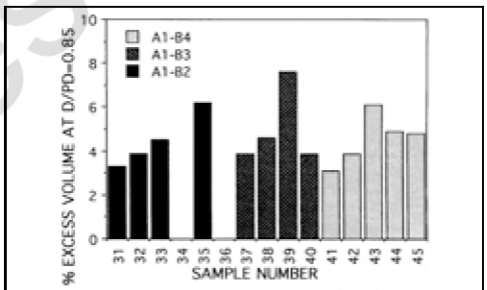


**FIGURE 9.** Comparison of excess volume for sample sets A1-B2, A1-B3 and A1-B4.

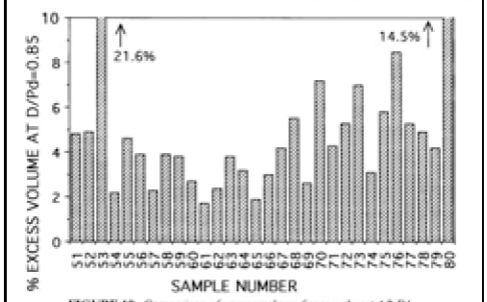


**FIGURE 10.** Comparison of excess volume for sample set A2-B1.

The annealed samples shown in Fig. 9 all have a similar behavior with most values falling

Values for the various sets of palladium are compared in Fig. 3, 4, 5 and 6. Figure 3 shows the sample set containing pure palladium which was not annealed. Adjacent samples show a wide variation in this property. A loading current of 800 mA seems to produce a larger average value compared to a current of 80 mA. The effect of temperature during loading is not clear because of the large scatter in the values.

Figure 4 compares samples in set A2-B1 which contained 500 ppm boron and were not annealed. This set shows a wider variation in values but contains samples having a higher limiting composition compared to the set not containing boron. As before, the effect of loading temperature is uncertain because of the general scatter in values.

Figure 5. compares three sets, A1-B2, A1-B3 and A1-B4, which contain pure palladium and are annealed. Because set A1-B2 was annealed in air, the samples showed a gray layer of oxide on the surface. Bits of this layer would flake off after loading, thereby biasing the compositions in the low direction by an unknown amount. Although set A1-B3 was annealed in vacuum, an oxide layer was also evident. Only set A1-B4 of this group had a bright metallic surface. This set had been etched in Aqua Regia following by a low temperature anneal. Although the treatment improved the reproducibility, only one sample above D/Pd=0.86 was found in the group.

Figure. 6 shows the annealed samples that contain 500 ppm boron. These samples also were coated by an oxide layer that flaked off on a few occasions. However, the thickness of this layer was less on samples in set A2-B3, a factor that may have caused the higher limiting composition. As previously noted, the Aqua Regia treatment improved reproducibility.

**Excess Volume (EV):**

In general, an increase in excess volume results in a reduction of the composition limit (Fig. 7). Part of the large variation is thought to result from the presence of two types of cracks. Type 1 is proposed to intersect the surface and, therefore, have a large effect on the retention of deuterium. In contrast, Type 2 cracks are proposed to exist completely within the solid material. Their effect is small because they can only change the local magnitude of the composition gradient. Although, the relative concentration of these two types can not be determined, many samples appear to contain a nearly equal mixture. Regardless of this uncertainty, a low excess volume appears to produce a benefit. Figure 8. compares the EV for sample set A1-B1. The samples loaded at 800 mA have a lower average than those loaded using 80 mA.

The annealed samples shown in Fig. 9 all have a similar behavior with most values falling between 4% and 7%. The extremes shown by the unannealed material are not present.

As can be seen in Figs. 10 and 11, the presence of boron introduces extremes in both the annealed and unannealed material.

**Deloading Rate:**

The deloading rate is expressed as D/Pd divided by the square root of time in minutes. Values between $1 \times 10^{-3}$ and $22 \times 10^{-3}$ were measured. No relationship to the composition limit was apparent. On the other hand, in spite of considerate scatter, the deloading rate seems to be larger for samples having a lower excess volume as shown in Fig. 12. The presence

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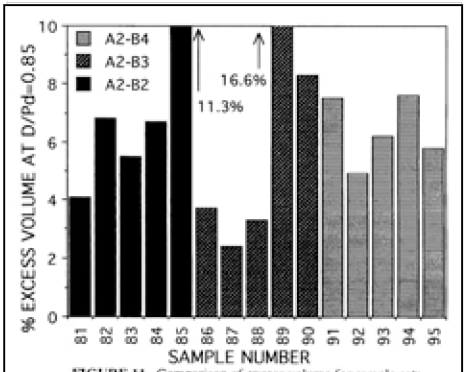


FIGURE 11. Comparison of excess volume for sample sets A2-B2, A2-B3 and A2-B4.

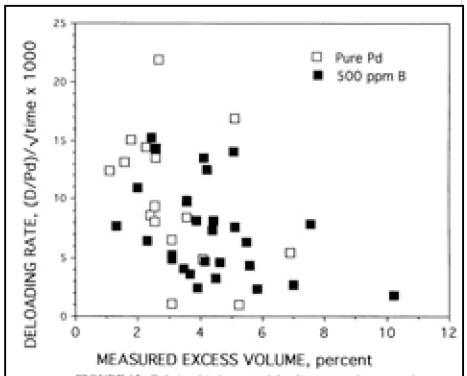


FIGURE 12. Relationship between deloading rate and excess volume for all samples.

of 500 ppm boron has no apparent effect.

**Open Circuit Voltage (OCV):**

The OCV at the conclusion of the loading varied between 1.01 V and 0.74 V as can be seen in Fig. 13. No relationship emerged to show the effect of boron. However, the use of 800 mA produced generally larger values compared to 80 mA.

On the other hand, the OCV gradually increased as the average composition increased during loading. Fig. 14 compares this behavior for several typical samples.

# PART II
# Excess Energy Study

## EXPERIMENTAL

**Method**

An isoperibolic-type calorimeter was used to measure energy production during electrolysis after the pretest had been run. The electrolyte, consisting of 0.3 N LiOD in $D_2O$, was precleaned using platinum as the cathode during the initial checkout procedure. A detailed description is given in the next section.

Typically, a fixed current was applied which was interrupted every 0.5 -1 h for about 10 sec. The OCV was measured during this interval. Every 24 hour, the current was stepped using arbitrary intervals from 50 mA to 3 A several times. The

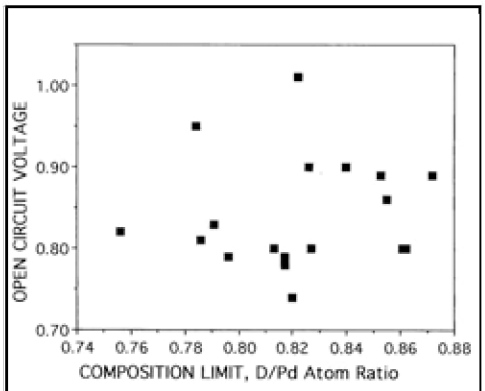


FIGURE 13. Open circuit voltage at the conclusion of loading.

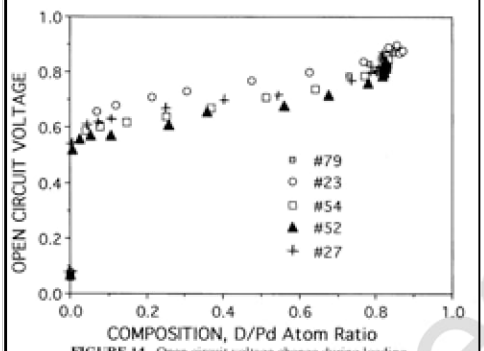


FIGURE 14. Open circuit voltage change during loading.

calorimeter was allowed to come to steady-state after each current change whereupon measurement of temperature, applied voltage and current were made. These measurements are identified by Set numbers in the following discussion.

The cathode temperature was continuously monitored and used to indicate when the production of excess power first started.

**Calorimeter**

The general configuration of the Pyrex Isoperibolic calorimeter is shown in Fig. 15. It consists of an inner, stirred cell and a surrounding jacket through which constant temperature (±0.02°) water flows. Temperature (±0.01°) was measured at three locations within the cell — at the top of the anode, at the bottom of the anode, and at a glass enclosed thermistor pressed against the cathode. Temper-ature is also measured where the fluid enters the jacket and where it leaves.

The temperature difference across the cell wall is determined by subtracting the average jacket temperature from the average inner temperature based on the top and bottom temperatures. Applied power is calculated by multiplying the applied current (±0.01A) by the cell voltage (±0.01 V) measured by the 4-wire technique within the calorimeter.

The OCV was measured in two ways. A Luggin capillary using an external platinum electrode allowed the OCV to be measured at a region involving perhaps 4 $mm^2$ of the cathode surface. The overall OCV produced by one side of the cathode was measured using an immersed platinum electrode located outside of the anode structure.

A recombining catalyst was located in the gas space. Consequently all $D_2$ and $O_2$ were recombined except that $O_2$ remaining after the $D_2$ had reacted with the palladium. A small tube carried the excess oxygen into a vessel containing oil. As the amount of excess oxygen increased, the oil was displaced on to a balance where the amount of oil was weighed to ±0.01 g. After suitable calibration, this weight was used to determine the D/Pd ratio during the experiment. An additional tube containing recombiner was located within the oxygen transfer tube. The temperature of this recombiner was monitored in order to demonstrate that all $D_2$ had been recombined within the calorimeter.

Several variations of the design were used involving mainly a change in the anode structure. Both platinum and palladium metals were used as the anode in separate experiments. The platinum was in the form of a wire mesh surrounding the cathode while the palladium was in the form of a wire spiral.

The cathode is crimped to a short piece of platinum wire after it was passed through a small hole. This wire is attached to the fixed platinum lead wire using a Teflon clamp, thereby allowing easy removal for weighing.

Calibration was performed using the electrolytic method during the first few days of electrolysis, before the palladium showed signs of energy production. This process involved increasing the current in steps between 80 mA and 3 A while measuring Δ T and applied power after the calorimeter had achieved steady values (≈7 min). A linear least squares line was fit to the data. The resulting equation was used to convert the measured ΔT to the amount of power being generated within the cell. Excess power resulted when the measured power was greater than the applied power. Although random variations of 200 mW were common, excess power was not claimed unless sustained values above 1000 mW were observed.

An additional indication of excess power resulted from a comparison between the top temperature and the temperature of the cathode. Normal electrolysis caused the cathode temperature to be hotter than the top of the fluid, in proportion to the applied power. In contrast, excess power production caused the cathode to become significantly hotter than expected. In addition, excess power production caused the cathode temperature to become erratic.

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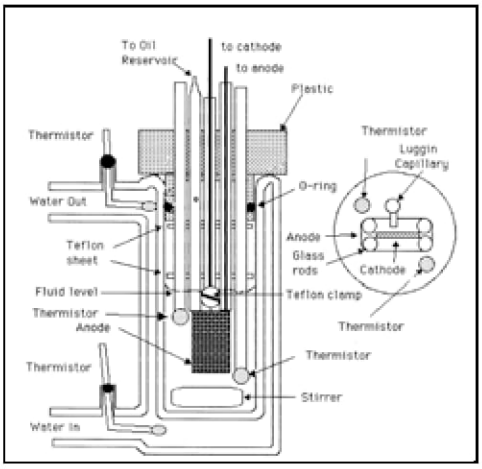


**Figure 15.** **Cross section of the calorimeter. The thermistor that contacts the cathode is not shown. The recombiner is located within a well in the Lucite lid and protected from electrolyte spray by the Teflon sheets. Variations on this design were used as described below.**

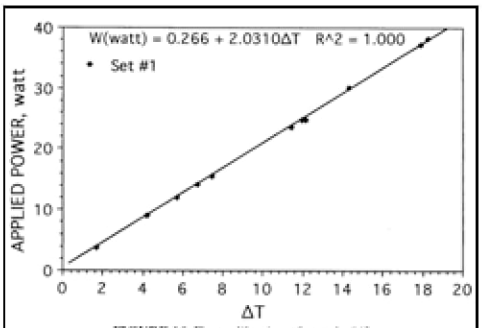


**FIGURE 16.** First calibration of sample #42.

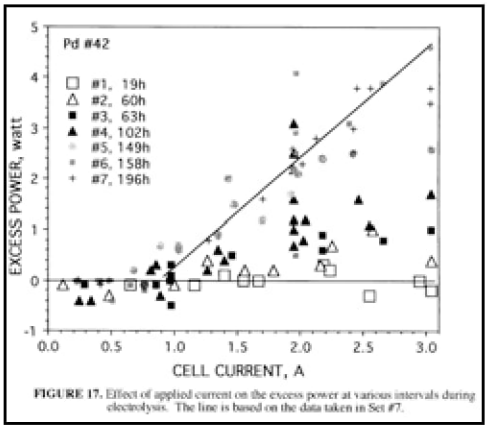


**FIGURE 17.** Effect of applied current on the excess power at various intervals during electrolysis. The line is based on the data taken in Set #7.

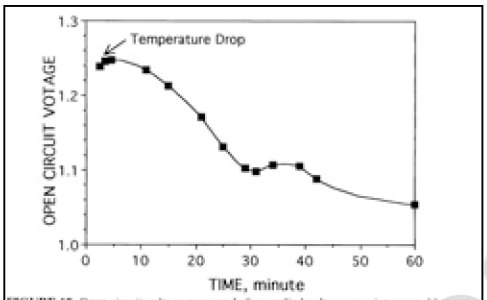


**FIGURE 18.** Open circuit voltage measured after applied voltage was interrupted between Sets #6 and #7. The initial rise occurred while the cell temperature dropped from 15° to 9°.

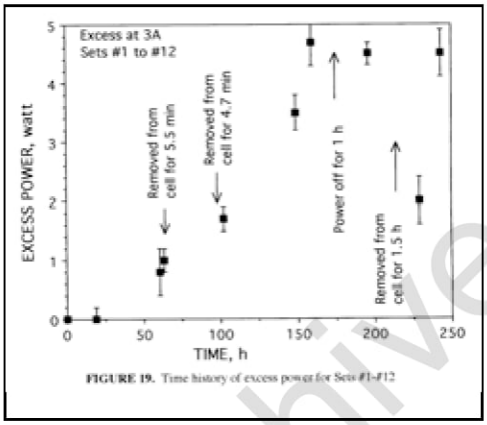


**FIGURE 19.** Time history of excess power for Sets #1-#12

# RESULTS

Sample #42a

The sample was placed in the calorimeter containing a platinum anode, and loaded at 0.4 A and 45°. The OCV was 1.04-1.06 V. After the jacket temperature had stabilized at 9°, the calorimeter was calibrated by changing the applied power as shown in Fig. 16. The sample was removed and found to have a composition of D/Pd=0.866 with an EV of 1%. An additional 30 h of electrolysis produced a composition of D/Pd=0.891. During subsequent electrolysis, periodic changes in applied current resulted in the behavior shown in Fig. 17.

The data show the characteristic critical onset current as observed by other workers.[1;4;5;6;9;10;11]

In addition, the consistent lack of apparent excess power below this critical value demonstrates that the apparent power production above this current is not caused by a change in calibration constant.

Between sets #6 and #7, the applied voltage was interrupted for 1 hr while the OCV was measured. As can be seen in Fig. 18, the OCV rose slightly as the cell cooled after the applied power was turned off. After 30 min, an arrest in the voltage was apparent. Later studies showed the same effect following by an approach to a constant value near 1.02 V that lasted for several hours. Samples not producing excess power show a much different behavior.

The time history of the excess power at 3 A is shown in Fig. 19. In spite of two occasions when the sample was removed from the cell for brief periods, the amount of excess power continued to increase. Only power interruptions for 1 h at 177 h and again for 1.5 h at 216 h caused a reduction in excess power.

After Set #12, the D/Pd ratio was found to be 0.879. The sample was washed with Aqua Regia, polished with 400-600 mesh silicon carbide paper, heated to 110° in air, and again washed with Aqua Regia. This process was done in an attempt to eliminate the effect and to determine whether the effect could be reproduced in a previously "good" sample.

A fresh electrolyte was used in the calorimeter, the Luggin capillary tip was modified, and an internal reference electrode was placed in the cell.

Upon being returned to the cell, the OCV to the Luggin capillary was 0.00 V and 0.02 V to the internal reference electrode. Loading was commenced at 200 mA. After the loading process was finished, the cell was calibrated as previously described. After being electrolyzed at 2 A for 4 days, no excess power was apparent even though the OCV was as high as 1.13 V. The sample was removed from the cell and found to have a composition of 0.841 and an excess volume of 2%. After the sample was returned to the cell, regular bursts of excess energy were seen that caused abrupt increases in the cathode temperature along with increases in ΔT. The effect of applied current was much less significant and less reproducible than previously observed.

After day six (Fig. 20), the electrolyte was replaced by $D_2O$ containing 3N $Li_2SO_4$. Additional electrolysis at 1 A caused a modest increase in excess energy and the power bursts continued. The sample was removed and major changes were made in the calorimeter and the sample was modified.

Sample #42b

The calorimeter was made larger in diameter, the anode was changed to a single spiral of 1 mm palladium wire; two Luggin capillaries were placed in the cell, one looking at a spot and one looking at the average voltage of one side; the recombiner was placed in a thin-walled glass tube above the liquid rather than being exposed; and the electrolyte was changed to 0.4 N LiOD in $D_2O$. Use of a constant speed stirrer reduced the random variation in excess power.

The sample was polished with diamond to 1800 mesh, washed with Aqua Regia, and heated in air to 325°C. The OCV before electrolysis was 0.04 V. Loading was done at 80 mA and 9° C. After loading, the composition was D/Pd=0.816 with 2.8% excess volume.

Figure 21 shows the time history of excess power at 3 A. The cell was calibrated at day 0. Electrolysis at 1.5 A produced a steady increase in excess power until day 8. A current reverse on day eight produced a slight reduction on day 9. When the sample was removed on day 10 for weighing, the sudden reaction of the evolving deuterium with the air caused the sample to rapidly self-heat. This process caused loss of deuterium to D/Pd = 0.33.

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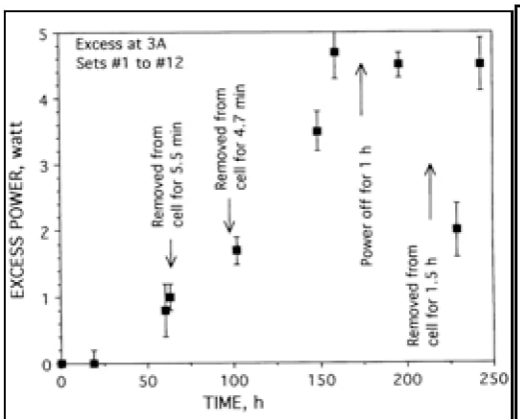


**FIGURE 19.** Time history of excess power for Sets #1-#12

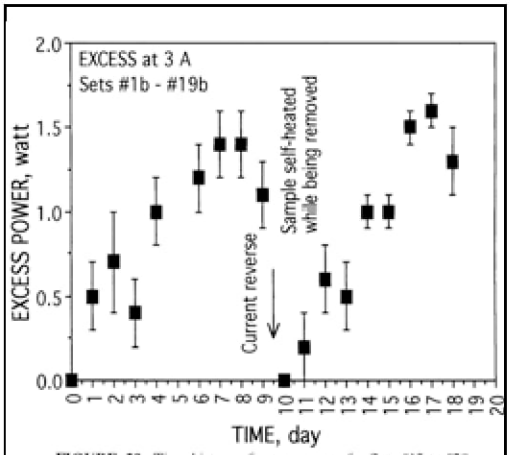


**FIGURE 20.** Time history of excess power for Sets #13 to #20.

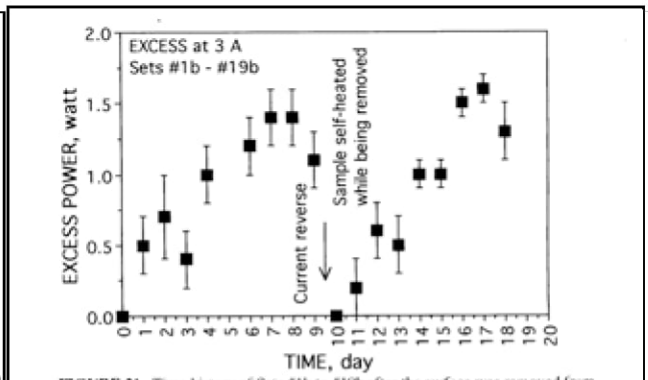


**FIGURE 21.** Time history of Sets #1b to #19b after the surface was removed from sample #42.

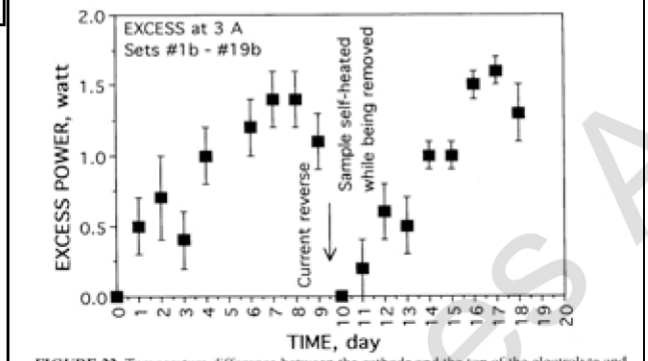


**FIGURE 22.** Temperature difference between the cathode and the top of the electrolyte and between the top and the bottom of the anode structure. No excess power was detected during Sets #11 and #12. Excess power was detected during Set #18.

The sample was returned to the calorimeter, a new calibration was made, and electrolysis was continued at 1.5 A. Again, a steady increase in excess power was produced. During this time the OCV was 1.04 to 1.06 V.

Excess power production caused changes in the temperature gradients between the cathode and the top of the fluid, and between the top and bottom of the cell. Figure 22 compares these temperature differences when excess power was being measured and when it was not. No power was detected during Sets #11 and #12 (Days 10 and 11 in Fig. 21). Excess power production at Set #18 (Day 17) caused both the cathode and top temperatures to be hotter than expected .

**Sample #84**

When placed in the calorimeter, the sample had a D/Pd ratio of 0.30 and was loaded at 0.5 A. After loading the D/Pd = 0.752 with an EV of 6.7% and an OCV of 1.00 V. Electrolysis was continued for 4 days with no sign of excess power. Excess power was seen on the sixth day as shown in Fig. 23 as Set #8. A critical onset current was apparent but was larger than needed for sample #42.

**Sample #38**

This study was made without using the stirrer in order to determine the effect of stirring on the apparent production of excess power. As can be seen in Fig. 24, the calibration constant shifted but remained sufficiently stable in the absence of stirring.

The sample was loaded at 80 mA and 9°. After loading, the composition was D/Pd=0.875 with EV=2.8% and OCV=1.03 V. Excess power production became apparent after 3 days while being electrolyzed at 1.5 A. Figure 25 shows the rather scattered growth in excess power over 15 days. Part of this scatter is caused by the amount of excess power being influenced by whether the current was being increased or decreased. As can be seen in Fig. 26, the excess power for Sets #10, #11, sand #12 increased as the current was increased to 3 A. Once at 3 A, the excess power continued to increase. A reduction in current caused the excess power to follow a different line. This behavior was seen many times during the study of this sample.

As was seen during the studies of other samples, the temperature difference between the cathode and the top of the electrolyte was greater while excess power was being produced compared to the value in the absence of excess power. This behavior was also seen when the temperature at the top of the electrolyte was compared to the bottom of the anode. Because stirring was not used in this study, the behavior was more pronounced.

**Sample #58**

The sample was washed with concentrated HCl, and loaded at 80 mA and 5°. After loading the composition was D/Pd=0.833 with EV=4.1%. Electrolysis was continued at 1.5 A in the calorimeter for 13 days. The OCV never rose above 0.6 V and excess power was not observed. After being removed from the calorimeter, the composition was D/Pd=0.792 with EV=4.8%.

## DISCUSSION

**Property Measurement**

All of the physical measurements show a variation between samples that is well outside of the errors in the measurements. Large differences are even seen between adjacent samples cut from the same rolled strip. This behavior strongly suggests that this same property variation is also present in each sample. Consequently, the average properties reported here are expected to have a wide variation within each sample as well. This realization helps explain why the "Pons-Fleischmann" effect is so difficult to reproduce. In addition, this wide variation in properties makes conclusions based on the behavior of a few samples very uncertain, even after they are given what seems to be identical treatment.

Annealing and surface treatments produce variable results. Only an etch using Aqua Regia seems to make the composition limit somewhat more uniform without a significant effect on the other properties. Annealing at 750° causes grain growth and a more uniform structure. However, a

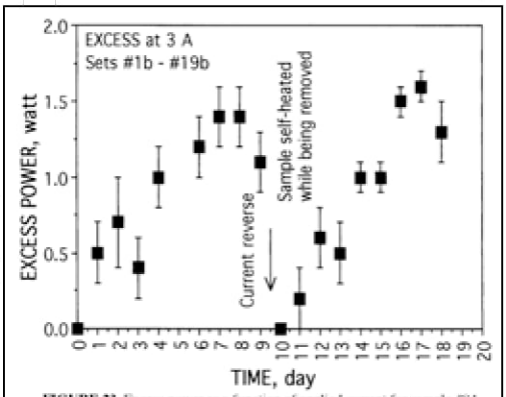


**FIGURE 23.** Excess power as a function of applied current for sample #84.

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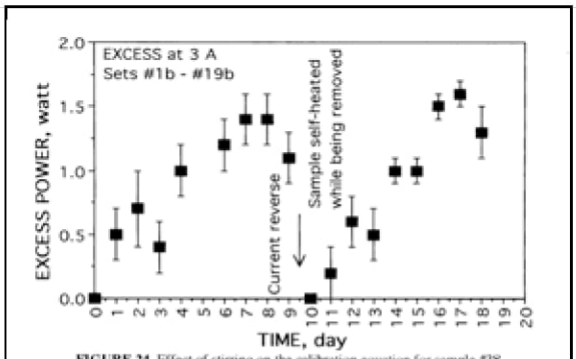


**FIGURE 24.** Effect of stirring on the calibration equation for sample #38.

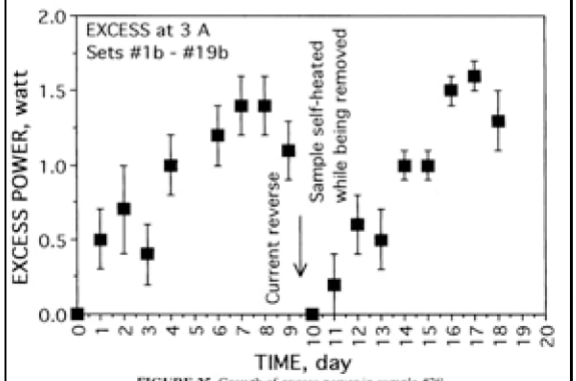


**FIGURE 25.** Growth of excess power in sample #38.

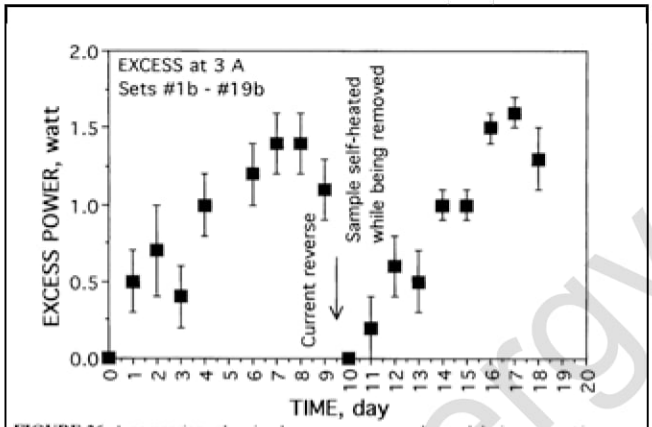


**FIGURE 26.** A comparison showing how excess power changed during current increase and current decrease during Sets #10, #11 and #12 of sample #38.

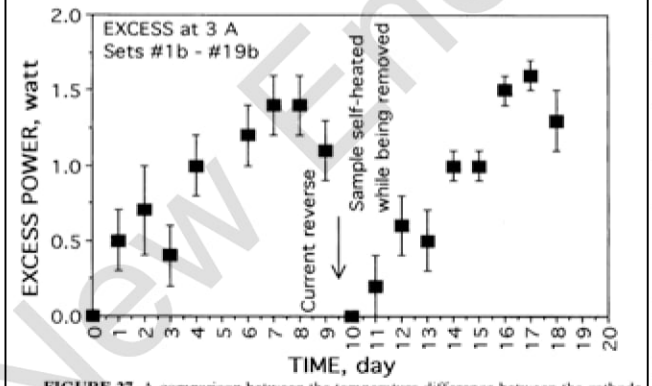


**FIGURE 27.** A comparison between the temperature difference between the cathode and the top of the electrolyte while excess power was being made and while it was not.

variable oxide layer was created on many samples by the process. In addition, the vacuum annealed material also shows evidence for attack by silicon pump oil in addition to oxygen. These effects are difficult to sort out because the batch size is too small.

The presence of boron results in an increased variation in the measured properties. Consequently, more potentially good as well as bad pieces are created. These extremes may be of benefit if a pretest method is used to remove bad samples.

The presence of excess volume causes a reduction in the composition limit. Because both values are averaged over the whole piece, the local behavior is not revealed. These local variations are expected to impact on the local conditions that are required to produce excess energy, thereby producing a very uneven energy source.

The maximum detected excess power is compared to the various properties in Table 3. Although the data set is still too small to make quantitative conclusions possible, excess power production seems to be related to the average composition, the amount of excess volume, and the open circuit voltage. One exception is found when the sample has a thick oxide layer. Perhaps a thin region next to the electrolyte is reduced to PdD and this layer produces energy without the need for a high average composition.

The behavior of sample #42 reveals a very important property of "good" material. Partial deloading results in excess power production just as soon as loading has been restored. Even after the surface has been removed, excess power production starts again after a somewhat longer delay. Apparently, "good" palladium remains good in spite of the removal of deuterium and major changes to the surface. Consequently, when the bulk material has the "correct" properties, a suitable surface will form and reform after removal. This behavior suggests that once suitable material has been identified, subsequent measurements will be reproducible.

The open circuit voltage of samples producing excess power show two characteristics. The values are above 1.0 V and an arrest or break in slope is seen as the value changes after the applied power is interrupted. This discontinuity in the time variation suggest a phase change in the surface region. As argued previously, this behavior suggests the formation of a phase having a higher deuterium content than is possible in β-PdD. Impurities are expected to have an additional effect.

**Calorimetry**

Claims for excess energy from the "Pons-Fleischmann" effect are very difficult for some people to believe. Therefore, the calorimetric studies need to be done using special care. Although the calorimeter used in this study was not especially sensitive, several methods were used to demonstrate that excess energy was actually being made.

Unlike many efforts, absolute heat measurements were not attempted. The claimed excess power is always relative to the power being produced by electrolysis in the absence of the effect. The effect is absent early in the study, after the current has been reduced below a critical value, or after the sample has been deloaded. Power production during each of these conditions was compared before, during, and after apparent excess power production. No significant change in the calibration constant was detected.

An additional indication of excess power can be obtained by measuring changes in temperature gradient within the cell. In particular, the temperature at the cathode is always found to increase while excess power is being made. Although this gradient change could introduce errors in the calculated amount of the excess power, it is too small to be the initial cause of the excess.

**ACKNOWLEDGEMENTS**

The author wishes to thank Mr. Yoshihisa Kamiya and Toshihisa Terazawa of the IMRA Materials Laboratory, and Dr. Keiji Kunimatsu of IMRA Japan for providing the samples. Prof. Hideo Ikegami was also very helpful in making the arrangements. Mr. Fred Jaeger (ENECO) provided some of the financial support needed to carry out these studies. Prof. Steve Jones (BYU) was very kind to provide some equipment that was used during the early phase of the work. Future studies have benefited from the help provided by Dr. David Nagel (NRL).

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TABLE 3
Comparison between measured properties and excess power production

| Sample Number | Designation | Excess Volume, % | Composition D/Pd | OVC | Excess Power, W (at 3 A) |
|---|---|---|---|---|---|
| Tanaka 1* | | 1.7 | 0.82 | | 7.5 |
| IMRA #38 | A1-B3 | 2.8 | 0.875 | 1.03 | 3.2 |
| Tanaka 4* | | 2 | 0.84 | | 2 |
| IMRA #42 | A1-B4 | 1 to 2 | 0.891 | 1.25 | 4.6 |
| IMRA #84** | A2-B2 | 6.7 | 0.752 | 1.00 | 1.5 |
| IMRA #58 | A2-B1 | 4.1 | 0.833 | 0.60 | 0.0 |
| Tanaka 2* | | 13.5 | 0.75 | | 0.0 |

* Tanaka samples from Refs. [4; 11]
** Oxide surface layer


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***Are the opponents of cold fusion and new energy "war criminals"?***

**Something to Ponder:**

## Fine Particles In Air Cause Many Deaths, Study Suggests

The above headline appeared in *The New York Times*, May 9, 1996. p. B10. in an article by science writer Philip J. Hilts. The article leads with this: "New calculations by an environmental group suggest that more than 5,000 deaths in the Los Angeles area and more than 4,000 in the New York area each year are caused by fine particles of air pollution that are inhaled." These come from the fossil fuel burning sector, stationary and mobile sources.

The study by the Natural Resources Defense Council, which covered 239 U.S. cities, suggests that 56,000 deaths per year could be prevented if currently non-regulated small particulates (2.5 microns diameter or smaller) were regulated. The study states that if a limit on the small particulates of 10 micrograms per cubic meter were imposed, 56,000 lives would be saved annually.

Some industry opponents of the conclusions of the study called them "junk science." However, this is not the first time that serious concerns about the health effects of small particulates have been raised—often by serious medical groups. Something to think about.—*EFM*


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# AN ULTRASONIC MOMENTUM TRANSFER PUMP

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**New York, NY 10012**

**ABSTRACT**

*This paper relates to an ultrasonic momentum transfer pump and its pumping action for fluids. It has particular reference to pumps for liquids that would replace electromechanical pumps in the main classification of compression pumps and force pumps.*

*The two categories of electromechanical pumps, namely, force and compression pumps, all require moving parts for operation and in some special way these parts are designed in relation to the amount of fluid to be pumped per unit time and the overall volume of the physical pump design. Methods of design for increased pressure equivalent to conventional pumps are discussed along with several "non-pump" applications relying on this technology.*

*A theoretical treatment for sonoluminescence is covered to illustrate its use in this "non-pump" mode of the ultrasonic momentum transfer pump used as a possible blue water laser.*

## THEORY OF OPERATION

Consider a momentum transfer pump without using any moving mechanical parts, other than the transducer. The pump uses acoustic radiation forces to transfer momentum by elastic and inelastic collisions of phonons to the medium (fluid molecules), resulting in a flow gradient of the medium in a resultant direction opposite the acoustic energy source (transducer). It can be miniaturized; the fluid medium is totally isolated from the transducer.

This momentum transfer pump can be used as a direct replacement for any conventional pump application and uses far less electrical energy for an equivalent mechanical pumping operation, if designed properly. If it does fail in operation, it can be easily repaired by replacing the few parts needed for operation, namely either the drive electronics or the acoustic transducer itself. Furthermore, using micro-electronic circuitry, the transducer and its associated drive electronics can be integrated into one hybrid component, truly allowing for a pump system with two major parts: a transducer assembly and the pump housing or chamber. The main housing or chamber itself can be a single molded or machined part, and as such, would not fail, for it is simply a metal or plastic enclosed chamber. Such a solid state pump functions via the momentum imparted by a specially designed ultrasonic transducer element. However, it may include for its operation other methods of generating ultrasonic radiation forces.

To understand the mode of operation of this pump, one must consider the phenomenon of a nondissipative fluid. The medium can be treated as a continuous one. This approximation is at all times valid, except for an extremely rarefied gas, or for a solid when the wavelengths of the waves are comparable with the interatomic distances.

If the problem can be considered one-dimensional by assuming that a wave of very broad front is traveling in the positive x direction such that all motions at the coordinate value x are the same, regardless of the y and z coordinates. This type of disturbance is known as a plane wave.

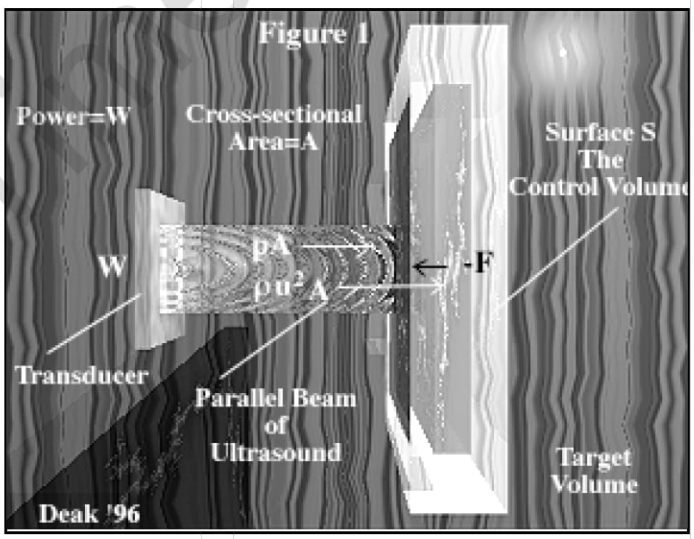
When a sound wave is propagated, the particles making up the medium are displaced from their rest or equilibrium positions. If the displacement of the particle is along the line of the direction of propagation of the wave, we call the wave longitudinal. Most sound waves impacting on fluids are longitudinal in character. If these displacements are at right angles to the direction of propagation of the wave, the wave is termed transverse. Usually, transverse waves are more common in very viscous liquids. Their importance in acoustics is primarily limited to sound waves in solids.

Acoustic radiation forces were first measured in l903 by Lord Rayleigh, and in recent years the practical importance of acoustic measurements of this type are seen in both the non-destructive testing and medical ultrasound areas. However, a more detailed approach to these measurements arose from research done in the medical ultrasound areas. The power outputs of ultrasonic transducers are measured with several parameters in mind. Usually the transducer under test is submerged in a tank of water and an ultrasonic beam emitted from the transducer is directed toward a target such as a hydrophone or a slab of rubber suspended as a pendulum. For medical applications, the measurements are made in water, because the characteristic acoustic impedance of water and human tissue are similar. It is accepted that the radiation force **F** exerted on totally absorbing target by an ultrasonic beam of power **W** is given by the equation:

$$\mathbf{F}=\mathbf{W}/c, \qquad \text{Eq.(1)}$$

where c is the speed of sound in the medium surrounding the target. For a beam power of 1 watt, and since the speed of sound in water is 1500 m $s^{-1}$ , the radiation force on an absorbing target is approximately 7 x $10^{-4}$ N $W^{-1}$.

This equation is rather simple, deceptive in fact, since the theory behind it is involved and has been the subject of intermittent debate since the early consideration of Lord Rayleigh and Brillouin. Some of the papers written on the theory are heavily mathematical and do not make clear the physical origin of the radiation force.




Consider Fig.1, where a parallel beam of ultrasound with power **W** is emitted from a transducer placed parallel to a target in a nondissipative fluid. Cross-sectional area A of that beam propagated through this medium of density p and is incident on a totally absorbing target. However, it will be assumed that a constraint force **-F** is applied to the target to prevent it from moving. This target is also assumed to be suspended like a pendulum, and the constraint force will be the horizontal vector component of the tensor in the suspension.

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When the magnitude of the constraint force is found, the radiation force will be known. To solve this problem, Euler's momentum theorem can be applied, which is a modification of Newton's second law of motion. This is applied not to a solid body, but to a material within a fixed region of space within a moving fluid, and it is stated as such:

Consider a fluid when at an instant **t** occupies the region of space bounded by the fixed closed surface S. In accord with Newton's second law of motion the total force acting on this mass of fluid is equal to the rate of change of momentum of the fluid. More explicitly, the resultant of the normal pressure thrusts on the surface S plus the resultant of the body forces acting on the enclosed fluid is equal to the rate of change of momentum of the enclosed fluid plus the rate of flow of motion outwards through S.

In Fig. 1, the fixed surface S is represented so that it encloses the target and the region bounded by S is referred to as the control volume. The constraint force is exerted in a direction parallel to the direction of propagation of the ultrasonic beam, and to determine its magnitude is simply a consideration of the forces and momentum in this direction. These relevant forces and rates of change of momenta to be considered are the hydrostatic pressure in the liquid which acts equally and in opposite directions through the left and right hand planes of the surface S, thus, it may be disregarded. However, in the ultrasonic beam the sound pressure superimposed on the hydrostatic pressure exerts a force on the left hand plane of the surface S. The sound pressure in the beam at the surface is denoted by p, and the force is given by p**A**.

The constraint force **-F** is the only significant force acting on the material within the control volume.

The rate of change of momentum

$$\partial M/\partial t$$

of the material within the control volume consists of the rate of change of momentum of the target and rate of change of momentum of the small quantity of liquid in the control volume.

In association with the propagation of the ultrasonic beam through the surface S, there is a movement of the liquid medium forward and backward through S and therefore a transport of momentum through S. If the particle velocity in the beam at the surface S is represented as u, the momentum per unit volume of liquid at the surface is pu, and the rate of flow of momentum inwards through a unit area of surface $pu^2$. The rate of flow into the control volume is therefore the product of $pu^2$ **A**. From Euler's momentum theorem.

$$pA - F = \frac{\partial M}{\partial t} - pu^2 A \qquad \text{Eq.(2)}$$

This equation describes the instantaneous balance between these forces and the rates of change of momenta in the system, and each term varies at the ultrasonic frequency. The quantity of importance to be determined is the constraint force **-F**, but what is strictly required is the steady constraint force **-F** which, on time average, is required to keep the target stationary. Note: a bar over a quantity will be used to represent a time averaged value. Eq.(2) therefore is averaged with respect to time. As stated previously, the partial derivative

$$\partial M/\partial t$$

represents the rate of change of momentum of the target plus the rate of change of momentum of the liquid in the control volume. The target is assumed to be at rest on time average and the presence of the solid target precludes any time-averaged movement of liquid within the control volume in the direction of propagation of the ultrasonic beam.

$$\therefore \frac{\partial M}{\partial t} = 0$$

$\therefore$ from Eq. 2

$$-F = -(p + \overline{\rho u^2})A \qquad \text{Eq.(3)}$$

is derived.

Consequently the radiation force is given by

$$F = (p + \overline{\rho u^2})A \qquad \text{Eq.(4)}$$

At first, it would appear difficult to accept that momentum is transferred from the ultrasound source to the fluid. The forward and reverse motion of an ultrasonic transducer that transfers movement into and out of the fluid volume element, thereby transferring momentum into and out of fluid volume element, giving a time-averaged momentum transfer of zero. However, as the volume element of the fluid moves forward through the volume, matter enters the control volume carrying with it momentum in the direction of propagation (positive momentum). As the liquid moves backward, matter leaves the control volume carrying with it momentum in the opposite direction (negative momentum). The removal of negative momentum from the material within the control volume is equivalent to the addition of positive momentum.

Further investigation(1) shows that when considering a longitudinal wave in a fluid, one can determine that it is a conceptual decision to make, relating to how the wave will be analyzed mathematically. As with the study of longitudinal waves in fluids, it is important to determine whether to use the Lagrangian, or material coordinates, or the Eulerian, or spatial coordinates. If one wants to study the displacement of a specific particle from its rest position, later taking into consideration for study its velocity and acceleration, then Lagrangian or material coordinates are used. Likewise, if one is determined to study the behaviour of the fluid at a fixed point in the fluid container, specifying the displacement, velocity, and acceleration of the fluid at that point regardless of which particles occupy the point in question at the various times in the study, then Eulerian or spatial coordinates are used. The difference between these two methods is generally of importance only when the intensity of the sound wave is very high, as in infinite amplitude sound or nonlinear acoustics. With interest in the area of nonlinear acoustics relating to the generation of sonoluminescence for fusion experiments, the realization of the difference between these two approaches is of importance. Summing this up, Lagrangian variables refer to a moving mass element of liquid and not to a fixed point in space, Eulerian variables refer to a fixed point x in space which may be occupied by different mass elements of the medium (liquid) at different times.

According to a general form of the pump, the responsive element of the momentum transfer pump is an ultrasonic source in general. It may however, be a specific source such as a piezoelectric transducer, an electrostriction transducer, stimulated Brillouin emission sources, surface generation in Quartz, thin-film piezoelectric transducers, depletion layer transducers, diffusion layer transducers, or silicon transducers.(1)

## DESIGN PHILOSOPHY

In its broadest sense, the momentum transfer pump in Fig. 2 comprises a preferably cylindrical shaped chamber or a chamber having an input port or inlet for fluid entry into to the main body of the chamber and at least one output port allowing fluid to exit or pass from said chamber into other external volume systems. Furthermore, fluid contained within the chamber acts as the medium for the transfer of acoustic radiation pressure from a conventional disc shaped piezoelectric transducer element having a parabolic front face plane disposed at one end. The transducer is driven by conventional electronic drive circuitry which generates

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electrical pulses to energize the piezoelectric transducer element; they form an acoustic source for providing an acoustic radiation field which emanates acoustic phonons. The electronic drive circuitry is connected to an electrical power source through electrical terminals.

The piezoelectric transducer is electrically stimulated by the drive circuitry and it, in turn, vibrates at its natural resonant frequency. This transducer can either be of a high-Q narrow bandwidth type, or a high-Q broad bandwidth type; but the transducer is not restricted to only these types. In the broadest sense, however, the transducer could be any device that can effectively transform electrical energy into mechanical energy. The transducer is acoustically coupled to the medium by a conventional coating or acoustic coupling device which enables the maximum transfer of acoustic radiation pressure into that medium. The radiation pattern emitted (phonons) from the transducer is that of a longitudinal wave of some nature (preferably a simple harmonic wave although a complex wave can be used) and this radiation establishes a traveling wave within the chamber which contains energy and momentum. As this traveling wave interacts with the medium through the components of absorption, scattering, and nonlinear propagation, it transfers its energy and longitudinal momentum to the medium. The interaction is constant; and instantly causes pumping action to occur. The effective radiation pressure generated by the transducer and coupled to the medium is directly proportional to the acoustic power transmitted per unit time through a unit area of the coupling device, which couples the transducer energy to the medium. However, it is also determined in part by a reflection coefficient. The reflection coefficient is determined by the ratio of the product of the density and velocity of the coupling medium to the density and velocity of the fluid medium to be pumped. If acoustic phonons from the transducer source are totally absorbed by the medium (inelastic collisions between phonons and the fluid molecules), then the radiation pressure is equal to the ratio of the power emitted from the transducer to the wave velocity in this medium; in summary, it is equal to the energy density. If acoustic phonons from source are totally reflected by the medium (elastic collisions between phonons and fluid molecules), then the radiation pressure is equal to the ratio of twice the power emitted from the transducer to the wave velocity in the medium; in summary, it is equal to twice the energy density. The real resultant radiation pressure falls somewhere on a time - averaged value for this imparted longitudinal momentum to the medium. The energy per unit volume of fluid is derived from a directly proportional relationship amongst the acoustic frequency, fluid density, velocity of sound through the medium, the fluid particle (molecular) displacement. Further, it is inversely proportional to the wavelength of the emitted acoustic wave from the transducer. By necessary design, the acoustic coupler does not interact with the emitted phonons to any significant degree and is essentially transparent to the acoustic waves; additionally it prevents any contact of the fluid medium with the external environment, and this feature serves an important purpose where the absence of contamination is vital. Lack of contamination is commonly required in the medical and pharmaceutical sectors. The chamber forms a non-resonant cavity at the operating frequency of the transducer. In this embodiment, the side walls of the chamber are devoid of any outlets.

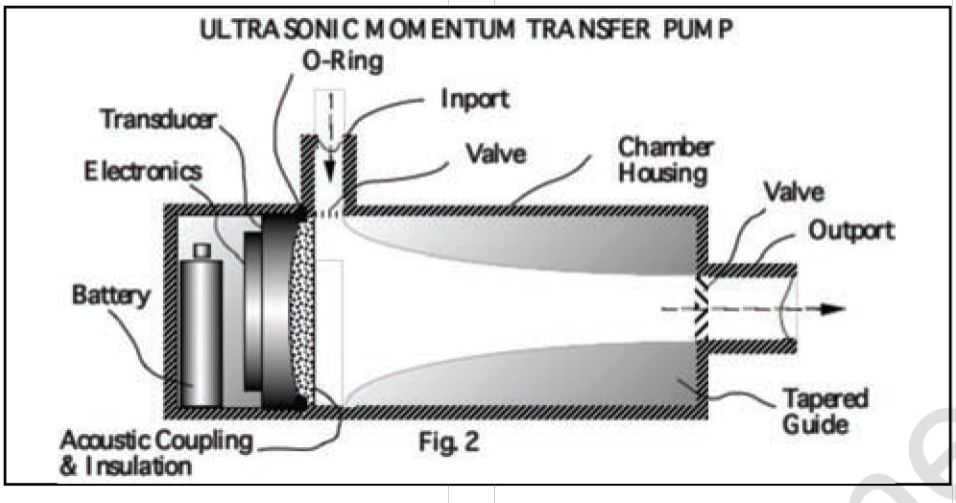

Fig. 2

The pump utilizes a tapered guide which serves to steer the medium flow gradient and the acoustic radiation in a concentrated direction which is opposite that of the transducer. An outer housing with removable rear cover is disposed over the chamber, transducer and the drive circuitry. This tapered guide establishes a very high radiation energy density which reduces the total chamber path length otherwise required to achieve the necessary momentum interaction. With increased radiation energy density, nonlinearity of the medium alters the radiation energy wave, thus creating radiation harmonics. These high frequency harmonic radiation components are propagated and absorbed within the medium. If the energy levels emitted from the transducer are of sufficient amplitude, cavitation will occur when the rarefactive acoustic pressure results in the formation of a vapour phase of the medium in the flow gradient. Cavitation is the process of forming micro-bubbles in a liquid by generating intense ultrasound waves.

When a cavity (gas or vapour bubble) is created and trapped in a fluid by an influentially strong ultrasound field, it undergoes nonlinear oscillations that can concentrate the average sound energy by over 12 orders of magnitude so as to create UV light (sonoluminescence). The history of sonoluminescence ("SL") covers more than five decades, and from previous research(2), sonoluminescence is well-established as a branch of physics. Sonoluminescence is a non-equilibrium phenomenon in which energy in a sound wave becomes highly concentrated so as to generate flashes of light in a liquid. These flashes comprise of over $10^5$ photons and they are too fast to be resolved by the fastest photo-multiplier tubes available. Basic experiments show that when sonoluminescence is driven by a resonant sound field, the bursts can occur in a continuously repeating, regular fashion. These precise 'clock-like' emissions can continue for hours at drive frequencies ranging from sonic to ultrasonic. These bursts represent an amplification of energy by eleven orders of magnitude. During the rarefaction part of the acoustic cycle the bubble absorbs energy from the sound field and its radius expands from an ambient value $R_o$ to a maximum value $R_m$. The compressional component of the imposed sound field causes the bubble to collapse in a runaway fashion (first anticipated by physicist Rayleigh about l9l7). The resulting excitation (heating) of the bubble contents (surface) leads to the emission of a pulse of light as the bubble approaches a minimum radius $R_c$. This manifests as a 50 ps (picosecond) pulse width and peak power of 30 mW. Cavitation results from the dynamic generalization of the Casimir effect(3) wherein dielectric media are accelerated and emit light. Further, it is the purpose of a paper published by Dr. Claudia Eberlein(4) to explain a novel theory of her's that "SL" is caused by the Unruh effect, which is a dynamic general-

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ization of the Casimir effect, and predicts radiation by "noninertially" moving quantum mirrors. However, this phenomenon is not exclusive to perfect mirrors such as perfect conductors. An intuitive structure leads to the process of the "zero-point" electromagnetic field exciting fluctuating dipoles in the perfect or imperfect mirror and these dipoles are the source of radiation when the mirror moves noninertially. Experiments show that just before the event of maximum bubble radius is achieved, the implosion velocity exceeds Mach-1 relative to the gas (for an acoustic period of 37.7 ns, Mach-1 is reached about 10 ns (nanoseconds) before $R_c$; $R_c$=the collapse radius); The SL light is also emitted just prior to the minimum ( about 5-10 ns prior to $R_c$); $R_m$ is about 40μm and $R_c$ is about 4μm.

Consider a bubble with radius $R_o$ and in equilibrium with hydrostatic pressure $P_o$ at t = 0, which will then expand isothermally in the first quarter of a period of the supersonic field. If the amplitude $P_A$ of the field is large enough, the radius of the bubble is known to expand and contract respectively around the complete pressure field cycle. The pressure field in area from $P_o$ - $P_A$ to $P_o$ + $P_A$ and the bubble contracts adiabaticaly with increasing pressure. Let $R_m$ be a radius of the minimum bubble, when the gas filling the bubble achieves the maximum temperature $T_{max}$.

One's interest lies with the contraction phase of the bubble where it was numerically ascertained by many authors that the contractions occurs very rapidly around the end of the third quarter of a period of the supersonic field, when the pressure field is almost, $P_o$ + $P_A$. Therefore one can describe the adiabatic contraction process by the several following equations:

Eq. (5)

$$(P_o+P_a)(V_{max}+V_{min}) = -\int_{V_{max}}^{V_{min}} P_d V, \quad PV^{\gamma} = \text{constant}$$

instead of directly solving the differential equation.

Eq. (6)

$$\frac{\partial^2}{\partial R^2} = -\frac{3}{2R}\left(\frac{\partial}{\partial R}\right)^2 + \frac{1}{\zeta R}\left[\left(P_o + \frac{2\sigma}{R_o}\right)\left(\frac{R_o}{R}\right)^{\gamma} - \frac{2\sigma}{R} - \frac{4\mu}{R}\frac{\partial}{\partial R} - P_o - P_d(t)\right]$$

After integrating, the maximum temperature and minimum radius is obtained as follows:

$$T_{max} = T_o Z_1^{\gamma-1}$$

Eq. (7)

$$Z = \left(\frac{R_{max}}{R_{min}}\right)^3 \sim \left[(\gamma-1)\frac{P_o+P_a}{P_o+\frac{2\sigma}{R_o}}\left(\frac{R_{max}}{R_o}\right)^3\right]^{\frac{1}{\gamma-1}}$$

Eq.(8)

if Z is much greater than unity, where $T_o$ is the initial temperature(5). An important realization is that this cavitation, which represents a vapour phase of the fluid, behaves as a very good reflector of acoustic energy and this produces the maximum momentum transfer to reflector of acoustic energy. This produces the maximum momentum transfer to the pumped medium, which is equal to twice the amount of the energy density. Therefore the generation of cavitation within the fluid is an essential component to be considered for "non-pump" operation in certain instances as described within.

The tapered guide as shown in Fig.2 is designed to conform to the focusing radiation pattern emitted by the transducer, which is preferably fabricated with a plano-parabolic front face. The purpose of this transducer design is for focusing (concentration) of emitted acoustic energy into the medium and this action allows for increased momentum transfer to the medium particles (molecules). Another variation of the transducer is a combination of two different parabolic transducer elements each having a parabolic face plane which are fabricated on a single substrate.

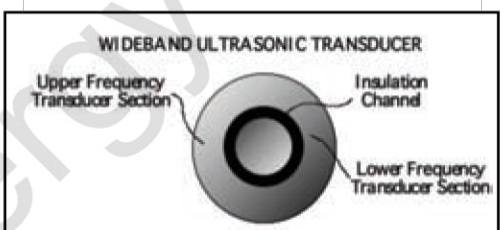

Fig. 3

Fig. 3 serves this visually and conveys that parabolic transducer **A**, has by design, a lower piezoelectric resonant frequency than the resonant frequency of the central parabolic transducer **B**. Their individually generated bandwidths are stationary deterministic signals and are comprised entirely of sinusoidal components at discrete frequencies. In periodic signals, all these discrete frequencies are multiples of some fundamental frequency, the reciprocal of the periodic time. In quasi-periodic signals, the frequencies of the various sinusoids are not harmonically related. If carried to extremes, this means that the ratio between at least two frequencies must be an irrational number such as $2^{0.5}$, but in practice it can be seen that quasi-periodic signals will typically arise from mixtures of two or more independent sets of harmonics, such as from an aircraft turbine engine with two independently rotating shafts. These stationary signals have a Gaussian probability density curve, the Equation (9) is the equation for this type curve.

$$p(x) = \frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}\right)$$

Eq. (9)

When they are both simultaneously excited by a common drive pulse or pulses, they both emit a band of acoustic energy waves hovering around their respective central resonant frequencies—separated enough in value to allow for a broadbanding effect to occur, whose overall resultant bandwidth is between the lower frequency half power point of transducer **A** and the higher frequency half power point of transducer **B**. Equation (10) describes this mathematical combination.

$$p(x) = \frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}\right) + \frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{1}{2}\frac{(x+\mu)^2}{\sigma^2}\right)$$

Eq.(10)

This additional transducer design feature enables a wider range of frequencies to be selected by drive circuitry. In fact the drive circuitry is designed to generates a wide range of frequencies within this bandwidth. If one of the factors involved with momentum transfer is fluid density and particle displacement, then for different fluids optimum pumping action can be realized by simply tuning to a frequency that corresponds to that optimized pumping action. This feature permits for the same pump to be used over a wide range of fluid viscosities without incorporating any necessary design changes. It is very important to realize that the operation of the present pump invention does not rely on any resonant cavity chamber design; therefore, no standing wave effects are utilized. This is the improvement of the invention over all the previously described prior art patents. In addition, it has focused and dual-frequency band transducer features. In the present invention, the principle of opera-

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tion resides in the transfer of momentum from the energy contained in the emitted acoustic phonons from the transducer to the medium particles; and not the resonant frequency of the chamber, or the careful placement of the input and output ports relative to the standing wave nodes and antinodes established within the resonant chamber, as is essential with all said prior art patents. However, that is not to say that this pump would not function in a resonant mode after design modification.

A multiplicity of transducers disposed in a parabolic plane so as to provide a resultant focused beam radiation field would enable very large pumping capacities to be achieved.

Fig. 4 represents another ancillary pump like configuration of the present invention whereby the previously configured output port is replaced with a window or transparent means is comprised of glass or some similar transparent material. With this version of the present invention, water ($H_2O$) is used as the medium and enters into the chamber by way of the input port and the vent and fluid input valve. The primary goal of this approach is *not* to have pumping action occur, instead the water remains within the chamber for the purpose of creating cavitation within the water. In operation, a very high energy density acoustic radiation pressure field is generated by an increased power pulse emanating from the drive circuitry and applied to the transducer. The energy density is further increased by utilizing a tapered guide and a parabolic transducer, which further concentrates the acoustic energy density. When the acoustic energy density increases beyond a certain value, cavitation occurs within the water and these micro-bubbles (cavitation) form a cluster near the window. These micro-bubbles expand and contract in unison with the emitted ultrasound and during the collapse phase of this activity blue light is emitted through the window. The phenomenon is a form of coherent sonoluminescence, which stems from the dynamical Casimir effect wherein dielectric media are accelerated and emit light.

A bubble in water is seen as a hole in a dielectric medium. Water is a polar molecule with a high dipole moment and responds to incident light as an oscillating dipole. If a group of water molecules is ordered into a helical structure of an axial extent greater than the wavelength of blue light, where the photon energy is 3.3 eV and if the individual molecules are oriented so that the dipole moment vector of the molecules is generally pointing in the incident light direction, the group in unison is excited at the frequency of incident light. This sonoluminescence may be a highly ordered arrangement of water molecules in a liquid crystalline state scattering incident light in the Raman band. However, the sound wave is important. In the expansion, the molecular order is lost because the intermolecular spacing exceeds the range of electrostatic interaction. However, in compression the molecules are confined to a spherical geometry and they are ordered into a configuration in resonance with the incident light. This blue light in phase with the ultrasonic pulsing is a cooperative lasing action. The sonoluminescence lasing action, collectively termed a *blue water laser*, may amplify the energy of the incident blue light because of the molecular resonance and represent an energy gain in the reflected blue light.

***Dr. Deak, a true Renaissance man, is a theoretical physicist and an electrical engineer. He is also a visual artist, whose paintings—in part generated by computer wizardry—are on display in New York City.—EFM***

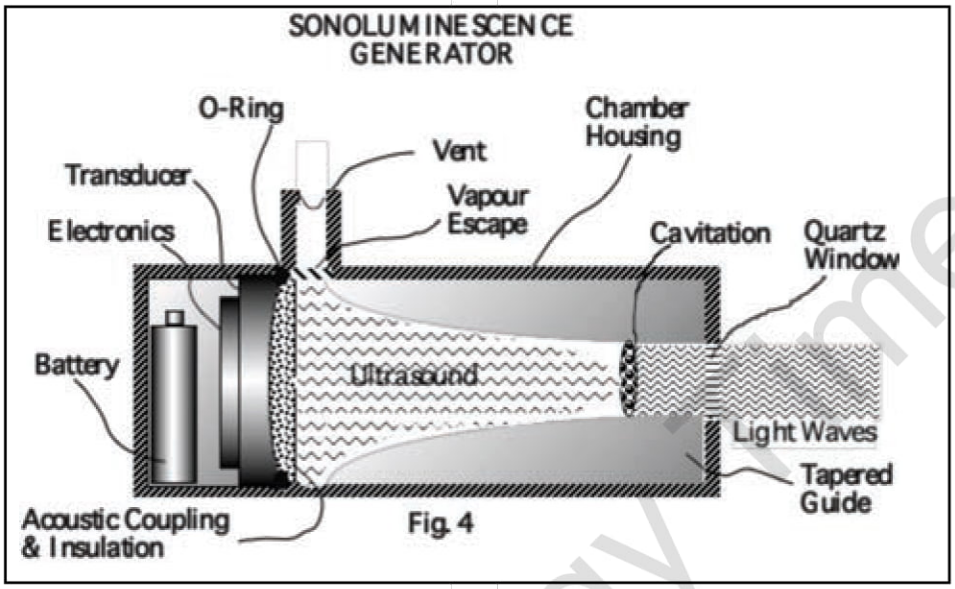

Fig. 4


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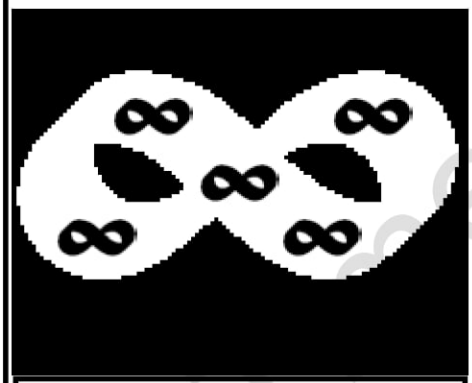

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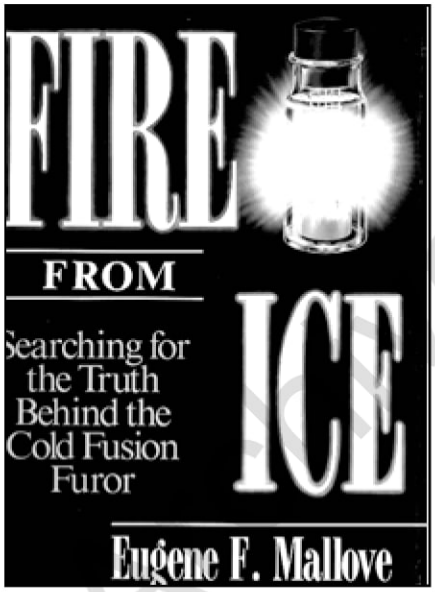


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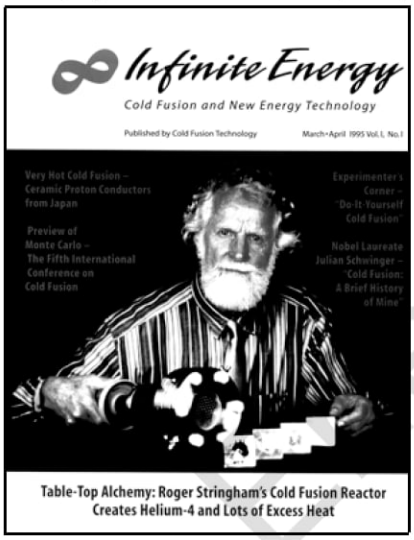

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